PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H04B 7/216, H04Q 7/34 — A1

(11) International Publication Number: WO 99/41853

(43) International Publication Date: 19 August 1999 (19.08.99)

(21) International Application Number: PCT/KR99/00075

(22) International Filing Date: 12 February 1999 (12.02.99)

(30) Priority Data:
1998/4498 14 February 1998 (14.02.98) KR
1998/13958 18 April 1998 (18.04.98) KR

(71) Applicant: SAMSUNG ELECTRONICS CO., LTD. [KR/KR]; 416, Maetan-dong, Paldal-gu, Suwon-shi, Kyungki-do 442-370 (KR).

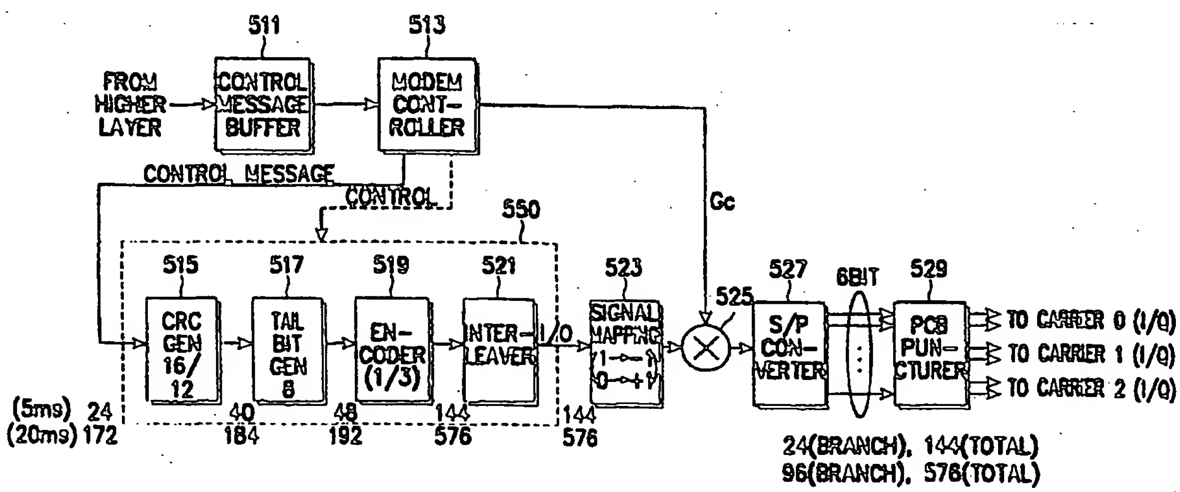
(72) Inventors: KIM, Young, Ki; Sungkyung Apt., 12-1401, Taechi-dong, Kangnam-gu, Seoul 135-280 (KR). AHN, Jae, Min; Puleunsamho Apt., 1109-303, Irwonpon-dong, Kangnam-gu, Seoul 135-239 (KR). YOON, Soon, Young; 165, Karak-dong, Songpa-gu, Seoul 138-160 (KR). KANG, Hee, Won; 1499, Myonmok 7-dong, Chungnang-gu, Seoul 131-207 (KR). LEE, Hyun, Suk; Jugong Apt., 4-danji, 420-106, Chamshil 3-dong, Songpa-gu, Seoul 138-790 (KR). PARK, Jin, Soo; 70-1, Panpo 4-dong, Socho-gu, Seoul 137-044 (KR). LEE, Min, Sou; 255-189, Shillim 9-dong, Kwanak-gu, Seoul 151-019 (KR).

(74) Agent: LEE, Keon, Joo; Mihwa Building, 110-2, Myongryun-dong, 4-Ga, Chongro-gu, Seoul 110-524 (KR).

(81) Designated States: AU, BR, CA, CN, JP, RU, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: DATA COMMUNICATION DEVICE AND METHOD FOR MOBILE COMMUNICATION SYSTEM WITH DEDICATED CONTROL CHANNEL



(57) Abstract

A CDMA communication system provides a dedicated control channel capable of efficiently communicating control messages between a base station and a mobile station. In a dedicated control channel transmission device, a controller determines a frame length of a message to be transmitted and outputs a frame select signal corresponding to the determined frame length. A message generator generates frame data of the message to be transmitted according to the frame select signal. A transmitter spreads the frame data and transmitting the spread frame data through a dedicated control channel. In a dedicated control channel reception decive, a despreader despreads a received signal. A first message receiver deinterleaves and decodes the despread signal in a first frame length to output a first message, and detects a first CRC corresponding to the decoded signal. A second message receiver deinterleaves and decodes the despread signal in a second frame length to output a second message, and detects a second CRC corresponding to the decoded signal. A controller selects one of the first and second messages according to first and second CRC detection results.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

DATA COMMUNICATION DEVICE AND METHOD FOR MOBILE COMMUNICATION SYSTEM WITH DEDICATED CONTROL CHANNEL

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a data communication device and method for a mobile communication system, and in particular, to a device and method for communicating control information for a data communication service using a dedicated control channel in a mobile communication system which provides a multimedia data communication service.

2. Description of the Related Art

Today, mobile communication systems tend to use a CDMA (Code Division Multiple Access) technology. To transmit control signals for call processing, a conventional CDMA mobile communication system based on the TIA/EIA IS-95 standard multiplexes the control signals to a traffic channel for transmitting voice information. The traffic channel has a fixed frame length of 20ms, and a signal traffic with the control signals transmits the entire frame message by a blank-and-burst technique or shares the frame with a main user traffic by a dim-and-burst technique to transmit the control signals.

Although this signaling technique is available for an IS-95 CDMA mobile communication system which provides the voice service only, it is unavailable for

a CDMA mobile communication system which provides a multimedia data service including a packet data service as well as the voice service. That is, the CDMA mobile communication system for the multimedia data service should include channels for the voice and data services to flexibly allocate the channels at the users' requests. To this end, the CDMA mobile communication system includes a voice traffic channel (or fundamental channel) and a packet traffic channel (or supplemental channel).

Conventionally, for the data service through the fundamental channel (or voice traffic channel) and the supplemental channel (or packet traffic channel), the CDMA mobile communication system should maintain the fundamental channel to transmit the control signal, even in a state where there is no communication between a base station and a mobile station, resulting in a waste of the channel and the radio capacity. In addition, the conventional CDMA mobile communication system uses the fixed single frame length of 20ms without respect to the size of a message to be transmitted, which may cause a low throughput and a traffic delay.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a dedicated control channel structure capable of efficiently communicating a control message between a base station and a mobile station, a call control message of a upper layer and a control message for connection of a packet traffic channel, by proving a dedicated control channel with which the mobile station can exclusively communicate the control signal to the base station in a CDMA mobile communication system, and a method for operating the same.

It is another object of the present invention to provide a device and method for generating and communicating a control message having a variable frame length according to the size of a communication control message in a CDMA mobile communication system using a dedicated control channel.

It is still another object of the present invention to provide a device and method for adaptively intermittently communicating a control message on a dedicated control channel according to absence/presence of the control message in a mobile communication system using the dedicated control channel.

It is further still another object of the present invention to provide a frame data processing device and method, in which a reception device receives frame data transmitted in a discontinuous transmission mode, detects an energy of the received frame data and judges absence/presence of an effective frame so as to process the frame data according to the judgement.

It is yet another object of the present invention to provide a frame data processing device and method, in which a receiver receives frame data transmitted in a discontinuous transmission mode, detects an energy of the received frame data and judges absence/presence of an effective frame, so as to process the received frame data according to a frame detection result and an error detection result.

To achieve the above object, there is provided a dedicated control channel transmission device for a CDMA communication system. In the transmission device, a controller determines a frame length of a message to be transmitted and outputs a frame select signal corresponding to the determined frame length, so as to transmit the message having at least two different frame lengths. A message

generator generates frame data of the message to be transmitted according to the frame select signal. A transmitter spreads the frame data and transmitting the spread frame data through a dedicated control channel.

The message generator includes a CRC generator for generating CRC bits for the message in the frame length determined according to the frame select signal and adding the CRC bits to the message, a tail bit generator for generating tail bits and adding the generated tail bits to an output of the CRC generator, a channel encoder for encoding the tail bit-added frame data with a predetermined encoding rate; and an interleaver for interleaving the encoded message by a unit of the frame length determined according to the frame select signal.

Preferably, the message frame includes a 5ms frame and a 20ms frame, and the message includes a user message, a signaling message and a MAC (Medium Access Control) message.

Further, the dedicated control channel transmission device may include the message generators as many as the number of the frame lengths of the message to be transmitted and the respective message generators generate the frame data in the corresponding frame length.

The controller comprises a device for generating an output control signal to perform a discontinuous transmission mode when there is no message to transmit, and the transmitter comprises a path controller for controlling an output of the dedicated control channel in response to the output control signal. Here, the path controller comprises a gain controller whose output gain becomes zero in response to the output control signal.

In accordance with one aspect of the present invention, a dedicated control channel reception device includes a despreader for despreading a received signal; a first message receiver for deinterleaving and decoding the despread signal in a first frame length to output a first message, and detecting a first CRC corresponding to the decoded signal; a second message receiver for deinterleaving and decoding the despread signal in a second frame length to output a second message, and detecting a second CRC corresponding to the decoded signal; and a controller for selecting one of the first and second messages according to first and second CRC detection results by the first and second message receivers.

The controller comprises a frame decider for analyzing the first and second CRC detection results to decide a frame length of the received message and output a frame length decision signal, and a selector for selecting one of the decoded signals output from the first and second message receivers according to the frame decision signal.

In accordance with another aspect of the present invention, a dedicated control channel reception device comprises a despreader for despreading a received signal; a frame detector for detecting an energy of the despread signal in first and second frame lengths and outputting first and second frame detection signals according to the detection results; a first message receiver for deinterleaving and decoding the despread signal in the first frame length to output a first message; a second message receiver for deinterleaving and decoding the despread signal in the second frame length to output a second message; and a controller for selecting one of the first and second messages according to the first and second detection results.

The frame detector comprises first and second frame detectors. The first

frame detector has as a reference value a minimum energy value of a 5ms effective frame and compares an energy value of the received frame message with the minimum energy value of the 5ms effective frame to generate a first frame detection signal when the energy value of the received frame message is higher than the minimum energy value of the 5ms effective frame. The second frame detector has as a reference value a minimum energy value of a 20ms effective frame and compares an energy value of the received frame message with the minimum energy value of the 20ms effective frame to generate a second frame detection signal when the energy value of the received frame message is higher than the minimum energy value of the 20ms effective frame.

In accordance with further another aspect of the present invention, a dedicated control channel reception device comprises a despreader for despreading a signal received through a dedicated control channel; a first frame detector for detecting an energy of the despread signal in a first frame length to output a first frame detection signal according to the detection result; a second frame detector for detecting an energy of the despread signal in a second frame length to output a second frame detection signal according to the detection result; a first message receiver for deinterleaving and decoding the despread signal in the first frame length to output a first message and detecting a first CRC corresponding to the decoded signal to output a first CRC detection signal; a second message receiver for deinterleaving and decoding the despread signal in the second frame length to output a second message and detecting a second CRC corresponding to the decoded signal to output a second CRC detection signal; and a controller for selecting one of the first and second messages according to the first and second frame detection results and the first and second CRC detection results.

The controller comprises a frame decider and a selector. The frame decider analyzes the first and second CRC detection signals and the first and second frame detection signals, judges the received frame to have the second frame length when the second CRC detection signal and the second frame detection signal are received, judges the received frame to have the first frame length when the first CRC detection signal and the first frame detection signal are received, and judges the received frame to be an error frame when other CRC and frame detection signals are received. The selector outputs a corresponding one of the decoded signals output from the first and second message receivers upon receiving one of first and second frame length decision signals, and controls an output of the decoded signal upon reception of an error frame decision signal.

In addition, the frame decider judges that no frame is received when none of the first and second frame detection signals and none of the first and second CRC detection signals are received.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings in which like reference numerals indicate like parts. In the drawings:

FIG. 1A is a flowchart illustrating a call setup procedure;

FIG. 1B is a flowchart illustrating a call release procedure;

FIG. 2A is a diagram illustrating a structure of a first length frame for a dedicated control channel according to the present invention;

FIG. 2B is a diagram illustrating a structure of a second length frame for the

dedicated control channel according to the present invention;

FIG. 2C is a diagram illustrating a structure of a second length traffic frame for the dedicated control channel according to the present invention;

FIG. 3A is a timing diagram illustrating a transmission time when the second length frame is used for the dedicated control channel in a mobile communication system according to the present invention;

FIG. 3B is a timing diagram illustrating a transmission time when the first length frame is used for the dedicated control channel in the mobile communication system according to the present invention;

FIG. 4 is a flowchart illustrating allocation and release procedures for a dedicated control channel and a dedicated traffic channel in the mobile communication system according to the present invention;

FIGs. 5A and 5B are diagrams illustrating a transmission device for a forward dedicated control channel in a mobile communication system according to the present invention;

FIG. 6 is a diagram illustrating a transmission device for a reverse dedicated control channel in the mobile communication system according to the present invention;

FIGs. 7A and 7B are diagrams illustrating reception devices for the dedicated control channel in the mobile communication system according to different embodiments of the present invention;

FIG. 8 is a diagram illustrating a reception device, having a frame detector, for the dedicated control channel in the mobile communication system according to another embodiment of the present invention;

FIG. 9 is a diagram illustrating a reception device, having separate frame detectors, for the dedicated control channel in the mobile communication system according another embodiment of the present invention;

FIG. 10 is a flowchart illustrating a method for detecting an effective frame in a frame detector (740) of FIG. 8 and a first frame detector (743) of FIG. 9;

FIG. 11 is a flowchart illustrating a method for detecting the effective frame in a second frame detector (741) of FIG. 9;

FIG. 12 is a flowchart illustrating a method for determining the length and presence of a frame in a frame decision block (730) of FIG. 8;

FIG. 13 is a flowchart illustrating a method for determining the length and presence of a frame in a frame decision block (750) of FIG. 9;

FIG. 14 is a diagram illustrating a reception device, having separate frame detectors, for the dedicated control channel in the mobile communication system according another embodiment of the present invention; and

FIG. 15 is a diagram illustrating a simulation result for the control messages having frame lengths of 5ms and 20ms according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A CDMA mobile communication system according to the present invention additionally includes a dedicated control channel (DCCH) with which a mobile station can exclusively communicate a control signal to a base station. The dedicated control channel is a control channel which is exclusively used in communicating the control signal between the base station and a particular mobile station. In particular, the dedicated control channel is used in exchanging the signals for controlling connection of the traffic channel.

Furthermore, in communicating a control signal using the dedicated control channel, the novel CDMA mobile communication system uses different-sized frames of first and second lengths according to the size of the control signal. That

is, for the small-sized control signal, the system generates and transmits the frame having the first length; for the large-sized control signal, the system generates and transmits the frame having the second length.

In addition, the CDMA mobile communication system determines presence/absence of the control message to be communicated, to control (repress) an output of the dedicated control channel when there is no control message to transmit and to form an output path for the dedicated control channel only when there exists the control message to transmit.

Now, reference will be made to the CDMA mobile communication system according to the present invention.

The dedicated control channel is used in exchanging the messages for controlling connection of the traffic channel between the base station and the mobile station. Prior to describing the structure of the dedicated control channel, the channels used in the novel CDMA mobile communication system and their uses will be mentioned first hereinbelow.

As to a forward link which is an RF (Radio Frequency) link for transmitting a signal from the base station to the mobile station, the common channels include a pilot channel, a sync channel and a paging channel (or a common control channel), and the user channels include a dedicated control channel, a voice traffic channel and a packet traffic channel. As to a reverse link which is an RF link for transmitting a signal from the mobile station to the base station, the common channel includes an access channel (or a common control channel) and the user channels include a pilot channel, a dedicated control channel, a voice traffic channel

and a packet traffic channel.

Therefore, a channel transceiver device for the base station and the mobile station in the CDMA mobile communication system consists of a pilot channel transceiver used for estimating the channel gain and phase and performing cell acquisition and handoff, a paging channel transceiver for performing initial synchronization and providing base station information, access channel information and neighbor cell information, a dedicated fundamental channel transceiver for transmitting/receiving voice data, a dedicated supplemental channel transceiver for transmitting/receiving packet data, and a dedicated control channel transceiver for transmitting/receiving setup/release and communication state-related control messages for the dedicated fundamental channel and the dedicated supplemental channel.

Table 1 shows uses of the respective channels for the forward link and the reverse link according to the services.

TABLE 1

Service	Forward Link Channel	Reverse Link Channel
Voice Service	Pilot Channel Voice Traffic Channel	Pilot Channel Voice Traffic Channel
High Quality Voice Service	Pilot Channel Voice Traffic Channel Dedicated Control Channel	Pilot Channel Voice Traffic Channel Dedicated Control Channel

High Speed Packet Data Service	Pilot Channel Packet Traffic Channel Dedicated Control Channel	Pilot Channel Packet Traffic Channel Dedicated Control Channel
Multimedia Service	Pilot Channel Voice Traffic Channel Packet Traffic Channel Dedicated Control Channel Paging Channel (Common Control Channel)	Pilot Channel Voice Traffic Channel Packet Traffic Channel Dedicated Control Channel Access Channel (Common Control Channel)
Short Message Service	Pilot Channel Paging Channel (Common Control Channel)	Pilot Channel Access Channel (Common Control Channel)

The CDMA mobile communication system may have an idle mode, a voice mode (or voice traffic channel using mode), a packet reservation mode (or packet traffic channel using mode) and a combined mode of the above-mentioned modes according to the service states. The dedicated control channel is preferentially used for a call providing a service for the packet reservation mode (i.e., a service using the packet traffic channel) among the above-mentioned modes. Here, the dedicated control channel is allocated to the mobile stations using the packet data service. However, exceptionally, the dedicated control channel may be used together with the voice traffic channel for the high quality voice service. In this case, the dedicated control channel can be shared by several mobile stations, instead of being exclusively used by a particular mobile station.

The call processing for the packet data service is compatible with an IS-95

call processing method. In call setup for the packet data service, the IS-95 origination message and channel allocation message which are modified to support the packet data service are used; in call release for the packet data service, an IS-95 release order message modified to support the packet service is used. A call setup procedure and a call release procedure, at the request of the mobile station, are shown in FIGs. 1A and 1B, respectively, by way of example.

Referring to FIG. 1A, the mobile station is synchronized with the base sation through the sync channel in step 111, and the base station sends system, access channel and neighbor cell parameters to the mobile station through the paging channel in step 113. The mobile station then outputs an origination message via the access channel in step 115. The base station then acknowledges the origination message via the paging channel in step 116, and allocates the traffic channels via the paging channel in step 117. When the traffic channels are assigned for communication between the base station and the mobile station, the system transitions to a connection establishment state in step 121, in which the dedicated control channels for the forward link and the reverse link are also allocated.

Referring to FIG. 1B, to release the call in the connection establishment state, the mobile station sends a control message for the call release request through the reverse dedicated control channel in step 151, and the base station then outputs a control message for the call release via the forward dedicated control channel in step 153.

As illustrated in FIGs. 1A and 1B, the differences between the message used in the call control procedure for the packet data service and the message of the IS-95 standard, are as follows. In the origination message (see Step 115 of FIG. 1A),

the packet data mode is added to the service option; in the channel assignment message (see Step 117 of FIG. 1A), packet data control channel allocation information is added to the allocation mode and used as an allocation indicator for the dedicated control channel, and dedicated control channel-related information (a channel identifier and a channel parameter) is included in an annexed field. Further, in the release order message (see Step 153 of FIG. 1B), the dedicated control channel-related information is included in the annexed field. Since the dedicated control channel is not yet established in the connection establishment procedure, the call setup-related messages are transmitted through the IS-95 channels (i.e., the sync, the paging and the access channels). In the state where the dedicated control channels for the forward and the reverse links are established by the call setup-related messages, the call control messages (e.g., the call release message) are transmitted through the dedicated control channel.

It is assume that the dedicated control channel according to the present invention has the following characteristics. That is, a data rate is 9.6Kbps, a frame length is 5ms or 20ms long, and a frame CRC consists of 16 bits (for 5ms frame) or 12 bits (for 20ms frame). Further, in a user mode, not a common mode, several dedicated control channels are required. The dedicated control channels operate only in a competitive transmission mode, not a reserved transmission mode. In the following description, the frame length 5ms is called a first length of the frame and the frame length 20ms is called a second length of the frame.

FIGs. 2A to 2C illustrate structures of a first length frame, a second length frame and a second length traffic frame, respectively.

FIG. 2A illustrates the first length frame of 5ms period, in which reference

numeral 211 denotes a fixed length message of an upper layer and reference numeral 212 denotes a first length frame communicated in a physical layer. The fixed length message may be a DMCH (Dedicated MAC (Medium Access Control) Channel) message, a DSCH (Dedicated Signaling Channel) message, etc. FIG. 2B illustrates the second length frame of 20ms period, in which reference numeral 221 denotes a variable length message of the upper layer and reference numeral 222 denotes a second length frame communicated in the physical layer. The variable length message may be the DSCH message. FIG. 2C illustrates a second length traffic frame of 20ms period, in which reference numeral 231 denotes a traffic structure of the upper layer and reference numeral 232 denotes a second length traffic frame communicated in the physical layer. The traffic may be a DTCH (Dedicated Traffic Channel) traffic.

The dedicated traffic channel has the functions of delivering packet data service-related control messages (e.g., a packet traffic channel allocation message, a layer 3 control message, etc.), delivering the IS-95 control message by encapsulating, delivering a short user packet, and transmitting a power control bit (PCB) through the forward link.

In order to increase the throughput of the CDMA mobile communication system, the frame length of the dedicated control channel should be variable. In particular, a frame length obtained by dividing a reference frame length by an integer should be used to improve the throughput. For example, when the reference frame length is 20ms, it is preferable to design the system to be able to use a 5ms or 10ms frame. In the embodiment, it is assumed that the 5ms frame is used. In this way, it is possible to increase the throughput and decrease the traffic delay, as compared with the case where the 20ms frame shown in FIG. 2B is used.

FIG. 3A illustrates a transmission time for the second length frame (i.e., 20ms frame), and FIG. 3B illustrates a transmission time for the first length frame (i.e., 5ms frame). The time required in sending a request message through the dedicated control channel and taking a corresponding action after reception of an acknowledge, is 80ms as shown in FIG. 3A when the 20ms frame is used, and is 20ms, which is a quarter of 80ms, as shown in FIG. 3B when the 5ms frame is used. Of course, this shows the case where the respective messages are so short as to be loaded into the 5ms frame, i.e., where the maximum gain can be obtained with the 5ms frame. Here, the reason that the throughput is increased is because the signal is efficiently transmitted, increasing the time at which the actual user data can be transmitted.

In the embodiment, the dedicated control channel is used in a control hold state and an active state out of the states for performing the procedures for the packet data service. Shown in Table 2 is the relationship between the logical channels and the physical channels for the forward and the reverse links.

TABLE 2

	Forward Link		Reverse Link	
	Logical CH	Physical CH	Logical CH	Physical CH
Control Hold State	DMCH DSCH	Dedicated Control CH	DMCH DSCH	Dedicated Control CH
Active State	DMCH DSCH DTCH	Dedicated Control CH	DMCH DSCH DTCH	Dedicated Control CH

	DTCH	Packet Traffic CH	DTCH	Packet Traffic CH

In Table 2, the dedicated MAC channel (DMCH) is a forward or reverse channel necessary for transmission of a MAC message, and is a one-to-one channel allocated in the control hold state and the active state for the packet service. The dedicated signaling channel (DSCH) is a forward or reverse channel necessary for transmission of the layer 3 signaling message, and is a one-to-one channel allocated in the control hold state and the active state for the packet service. The dedicated traffic channel (DTCH) is a forward or reverse channel necessary for transmission of the user data, and is a one-to-one channel allocated in the active state for the packet service.

The control hold state in Table 2 means a state where although the dedicated MAC channel DMCH and the dedicated signaling channel DSCH are allocated to the forward and reverse links, an RLP (Radio Link Protocol) frame with the user data packet cannot be exchanged because the dedicated traffic channel DTCH is unestablished. In addition, the active state means a state where the channels DMCH, DSCH and DTCH are allocated to the forward and reverse links so that the RLP frame with the user data packet can be exchanged.

Therefore, FIGs. 2A to 2C show the logical channel message frames or data mapped into the physical channel frames. Here, reference numerals 211, 221 and 231 denote the logical channel message frames, and reference numerals 212, 222 and 232 denote the physical channel message frames.

Now, a description will be made as to the structures and operations of the first length frame and the second length frame for the dedicated control channel. The frame length of the dedicated control channel varies dynamically according to the kind of the messages. At the receiver, the frame length is determined every 5ms.

In a packet channel connection control mode for transmitting the fixed length message of 5ms shown in FIG. 2A, request/allocation for the forward and reverse packet traffic channels is made using a 5ms request/acknowledge message. The forward packet traffic channel allocation which begins at the base station is independent of the reverse packet traffic channel allocation which begins at the mobile station. The connection control messages include a packet traffic channel request message, a packet traffic channel allocation message and a packet traffic channel acknowledge message. These messages are transmitted through the DMCH among the logical channels. Table 3 shows channel allocation message fields for the reverse packet traffic channel, for the first length frame of 5ms.

TABLE 3

Reverse Packet Traffic Channel Allocation Message (24 bits)	
Field	Length (bits)
Header Information	5
Sequence	3
Start Time	2
Allocated Rate	4
Allocated Duration	3

Reserved Bits	7

In Table 3, the respective fields are defined as:

"Header Information" - identifier, direction and type (i.e., request and acknowledge) of the message

"Sequence" - sequence of the message

"Start Time" - channel using start time

"Allocated Rate" - rate of the allocated channel

"Allocated Duration" - channel using duration for the allocated channel

The 24-bit fixed length message in the form of Table 3 is transmitted with the 5ms frame, shown in FIG. 2A, of the dedicated control channel.

FIG. 4 is a flowchart illustrating a procedure for allocating and releasing the packet traffic channel through the dedicated control channel, while the system transitions from the control hold state to the active state and then transitions again from the active state to the control hold state.

Referring to FIG. 4, it is assumed in step 411 that the base station and the mobile station maintain the control hold state in which the dedicated control channel is connected. In this state, the mobile station generates a control message for requesting allocation of the reverse packet traffic channel through the dedicated MAC channel DMCH and sends it through the physical channel, in step 413. The base station then generates a control message for allocating the reverse packet traffic channel via the dedicated MAC channel DMCH and sends the generated control message via the physical channel, in step 415. Then, the base station and the

mobile station transition to the active state where the packet traffic channel is allocated to communicate the packet data, in step 417. In this active state, the mobile station initializes a T_{active} timer in step 419 to check the time at which transmission of the packet data is discontinued. Here, if transmission of the packet data is continued before a value of the T_{active} timer expires, the active state is maintained and then the step 419 is repeated to initialize the T_{active} timer.

However, if transmission of the packet data is not continued until the value of the T_{active} timer expires, the mobile station perceives this in step 421, and generates a control message for requesting release of the reverse packet traffic channel through the dedicated MAC channel DMCH and sends the generated control message through the physical channel, in step 423. In response to the control message, the base station generates a response control message for release of the reverse packet traffic channel via the dedicated MAC channel DMCH and sends the generated control message via the physical channel, in step 425. Subsequently, the base station and the mobile station release the reverse traffic channel and transition to the control hold state, in step 427, preparing for the next state.

As illustrated in FIG. 4, in the procedure of requesting and allocating the reverse packet traffic channel, the mobile station generates the reverse packet traffic channel request message including the requested channel data rate information and sends it to the base station. The base station then analyzes the received message to determine whether the requested parameter can be supported or not and sends, in answer to the request message, the reverse packet channel allocation control message of Table 3 to the mobile station according to the determination. When an additional negotiation is required, the above-mentioned request and response procedures may be repeated. Further, if there is no packet data to transmit during

the packet data communication, the packet traffic channel releasing process is performed after a lapse of the time set in the T_{active} timer.

In a transmission mode for the variable length frame, the variable length message according to the IS-95 standard is divisionally loaded into the 20ms frames of the dedicated control channel, as shown in FIG. 2B. Specifically, the transmission modes may include a mode for transmitting the frame without error detection and correction by ACK/NACK (acknowledge/negative acknowledge), a mode where ACK/NACK occurs when an entire variable length message is received and retransmission is performed for the entire variable length message, and a mode where ACK/NACK is performed for the respective frames.

In a user data transmission mode, the RLP frames with the user traffic is divisionally loaded into the 20ms frames of the dedicated control channel, as shown in FIG. 2C. The user data transmission mode can be used in the event that it is inefficient to establish the packet traffic channel for transmitting the data because there is a small amount of the data to transmit.

Now, a description will be made as to the physical device for transmitting the frames of the dedicated control channel in the CDMA mobile communication system using the dedicated control channel described above.

First, referring to FIGs. 5A and 5B, the description will be given as to a frame transmission device for the forward dedicated control channel. In figures, a control message buffer 511 temporarily stores a control message communicated through the dedicated control channel. The control message buffer 511 should have a proper size to store one or more second length frames of 20ms. Further, the

control message buffer 511 interfaces a control message between an upper layer processor and a modem controller 513. Here, the upper layer processor sets a flag after storing in the control message buffer 511 the control message with the header information for discriminating the 5ms and 20ms frames according to the message type, and the modem controller 513 clears the flag after reading the control message, so as to prevent over-writing and over-reading.

After reading the control message stored in the control message buffer 511, the modem controller 513 analyzes a header of the control message to detect a message type, outputs a message (or payload) to be transmitted through the dedicated control channel according to the detected message type, and outputs a control signal according to the detected message type. Here, the control signal generated from the modem controller 513 is a frame select signal for selecting the first and second length frames. As for the message type, the control message may have a first control message of 5ms shown in FIG. 2A or a second control message of 20ms shown in FIG. 2B, and the size of the control data output from the modem controller 513 depends on the analysis result. That is, for the 5ms control message, the modem controller 513 outputs 24-bit data having the structure of Table 3; for the 20ms control message, the modem controller 513 outputs 172-bit data. Further, the modem controller 513 determines absence/presence of the control message to control an output of the dedicated control channel. That is, the modem controller 513 generates a first gain control signal when there is a control message to transmit, and generates a second gain control signal for repressing (checking) a signal transmitted to the dedicated control channel when there is no control signal to transmit. Here, the gain control signals are output control signals for controlling transmission output of the dedicated control channel. Although the present invention has been described with reference to an embodiment having the gain

controller placed at a prestage of a spreader, it is also possible to place the gain controller at a following stage of the spreader.

A CRC (Cyclic Redundancy Check) generator 515 adds CRC bits to the control message output from the modem controller 513 so that it can be possible to determine the frame quality (i.e., determine whether or not the frame has an error) at the receiver. Specifically, for the 5ms frame, the CRC generator 515 generates 16-bit CRC to output a 40-bit control message, under the control of the modem controller 513; for the 20ms frame, the CRC generator 515 generates 12-bit CRC to output a 184-bit control message.

A tail bit generator 517 generates tail bits necessary for termination of an error correction code. This tail bit generator 517 analyzes an output of the CRC generator 515 to generate the tail bits according to the analysis and adds the generated tail bits to the output of the CRC generator 515. Specifically, the tail bit generator 517 generates 8 tail bits and adds them to the output of the CRC generator 515. Therefore, for the 5ms control message, the control message output from the tail bit generator 517 is composed of 48 bits as represented by reference numeral 212 of FIG. 2A. Further, for the 20ms control message, the control message output from the tail bit generator 517 is composed of 192 bits as represented by reference numeral 222 of FIG. 2B.

An encoder 519 encodes an output of the tail bit generator 517. The encoder 519, used in the embodiment, is a convolutional encoder or a turbo encoder using an encoding rate 1/3. An interleaver 521 interleaves encoded control data output from the encoder 519. That is, the interleaver 521 changes arrangement of the bits within the frame by the frame unit of the message, so as to improve a tolerance for

a burst error.

The CRC generator 515, the tail bit generator 517, the encoder 519 and the interleaver 521 constitute a control message generation block 550 for generating the control message and transmitting the generated control message via the physical channel. FIG. 5A shows, by way of example, the structure in which the control message generation block 550 processes the control messages of both the 5ms and 20ms frames. However, it is also possible to include the control message generation blocks as many as the number of the frame sizes of the control message processed in the dedicated control channel, and generate the control message by selecting the control message generation block corresponding to the length of the frame to be transmitted by the modem controller 513. In this case, the respective control message generation block should include the CRC generator, the tail bit generator, the encoder and the interleaver according to the frame length of the corresponding control message.

A signal mapping block 523 converts a transmission signal by converting a transmission signal of the logic "1" to "-1" and a transmission signal of the logic "0" to "+1". A gain controller 525, a gain multiplier, forms or blocks a path for the control message, being transmitted, of the dedicated control channel according to a gain control signal Gc output from the modem controller 513. That is, the gain controller 525 performs a DTX (Discontinuous Transmission) mode of operation, in which the path of the dedicated control channel is formed according to the gain control signal when there is the control message to transmit, and the path of the dedicated control channel is blocked when there is no control message to transmit.

A serial-to-parallel (S/P) converter 527 multiplexes symbols of the control

message, output from the gain controller 525, to distribute them to spreaders for the corresponding carriers. Here, in the embodiment, 3 carriers are used, by way of example. In this case, there exist 3 carrier channels each having two phase branches (i.e., I and Q branches). Therefore, since the control message of the 5ms frame is composed of 144 symbols, the number of the symbols output through the I and Q branches for the respective carriers is 24. Further, since the control message of the 20ms frame is composed of 576 symbols, the number of the symbols output through the I and Q branches for the respective carriers is 96. Occasionally, the dedicated control channel transmitter may use a single carrier. In this case, the S/P converter 527 simply performs a symbol distribution function for the I and Q branches of the single carrier. A PCB (Power Control Bit) puncturer 529 punctures a control bit to be output to the mobile station via the forward link. Here, the control bit may be a power control bit PCB for controlling a reverse link power of the mobile station.

FIG. 5B illustrates a spreader for spreading the symbols output from the PCB puncturer 529. The embodiment includes the spreaders as many as the number of the carriers. For the convenience of explanation, FIG. 5B shows the structure of the spreader corresponding to a particular carrier. Referring to FIG. 5B, an orthogonal code generator 535 generates an orthogonal code used for the dedicated control channel. Here, the orthogonal code may be a Walsh code or a quasi-orthogonal code. Multipliers 531 and 533 multiply the orthogonal code output from the orthogonal code generator 535 by the corresponding I and Q branch signals, respectively, to output spread control signals for the forward link dedicated control channel. Although the invention has been described with reference to an embodiment which spreads the orthogonal code using BPSK (Bi-Phase Shift Keying) modulation, it is also possible to spread the orthogonal code using QPSK (Quadrature Phase Shift Keying) modulation.

A modulator 537 receives PN codes (Pseudo random Noise sequence) PNi and PNq output from a undepicted PN sequence generator to spread the I and Q branch signals. For the modulator 537, a complex multiplier can be used.

Referring to FIGs. 5A and 5B, when the quasi-orthogonal code is used, the number of the code channels can be extended at the expense of an FEC (Forward Error Correction) rate. Further, in the forward link, a power fluctuation due to punctuation of the power control bit can be prevented through code bit level frame staggering.

In FIG. 5A, the frame length (5ms or 20ms) of the control message to be transmitted is determined in the modem controller 513. That is, the modem controller 513 determine the frame length by examining the header information representing whether the control message stored in the control message buffer 511 is a 24-bit fixed length control message or a variable length control message. When the header information represents the 24-bit fixed length control message, it is determined that the control message has the 5ms frame length. When the header information represents the variable length control message, it is determined that the control message has the 20ms frame length. The modem controller 513 generates a signal for controlling the control message generation block 550 according to the frame length determination. Here, the numerals in sub-blocks 515, 517, 519 and 521 of the control message generating block 550 represent the bit numbers according to the frame lengths; for the 5ms frame, the upper parameters are used, and for the 20ms frame, the lower parameters are used.

In addition, the modem controller 513 controls the dedicated control channel in the DTX mode. That is, in the preferred embodiment, the signaling message and

the MAC-related message for the data service are transmitted/received through the dedicated control channel, contributing to an effective use of the channel capacity. The IS-95 system is structured to multiplex the voice traffic and the signaling traffic, so that the voice and signaling channels should be normally opened for the data service. However, since the dedicated control channel of the invention operates in the DTX mode, it is not necessary to normally open the channel for the control signal. When there is no signal information to transmit, it is possible to suppress a transmission power in a DTX gain controller, thus effectively utilizing the radio capacity.

As to the DTX transmission mode of operation, when it is perceived that the control message buffer 511 has no control message to transmit, the modem controller 513 generates the second gain control signal so that the gain controller 525 maintains an output of the dedicated control channel to be "0". That is, the modem controller 513 generates the first gain control signal (Gc = predefined gain) when there is the control message to transmit, and generates the second gain control signal (Gc = 0) when there is no control message to transmit. The gain controller 525 may be positioned following a spreading stage. However, in this case, there may arise a problem of PCB puncturing. Further, although the invention has been described with reference to an embodiment performing the DTX mode for the dedicated control channel using the gain controller 525, it is also possible to block the signal path using a switch when there is no control signal to transmit to the dedicated control channel.

FIGs. 5A and 5B illustrate the structure of the dedicated control channel transmission device for the forward link (from the base station to the mobile station). The dedicated control channel transmission device for the forward link

should perform a PCB puncturing operation for controlling a transmission power of the mobile station. However, a dedicated control channel transmission device for the reverse link (from the mobile station to the base station) does not have to perform the PCB puncturing operation. Accordingly, the dedicated control channel transmission device for the reverse link can be constructed as shown in FIG. 6.

Referring to FIG. 6, the dedicated control channel transmission device for the reverse link has the same structure as the dedicated control channel transmission device for the forward link, except for the S/P converter, the spreader structure, the encoding rate of the convolutional encoder. In the embodiment, the encoding rate of the forward link encoder is 1/3 and the encoding rate of the reverse link encoder is 1/4.

In transmitting the control signal using the reverse dedicated control channel, the dedicated control channel transmission device for the reverse link also determines the frame length according to the size of the control message and transmits the control message by the determined frame length unit. Further, the dedicated control channel transmission device for the reverse link examines presence/absence of the control message to transmit through the reverse dedicated control channel, to suppress an output of the reverse dedicated control channel when there is no control signal to transmit and to form an output path for the reverse dedicated control channel only when there is an actual control message to transmit.

In FIG. 6, a spreader 631 spreads the control signal output through the dedicated control channel using the orthogonal code and the PN sequence.

A device for receiving the control signals transmitted through the forward or

reverse dedicated control channel should determine the frame length of the control message to process the control message. The dedicated control channel reception device for the forward or reverse link can be constructed as shown in FIG. 7A and 7B.

FIGs. 7A and 7B illustrate the dedicated control channel reception devices for the forward or the reverse link according to the present invention. The reception devices determine the frame length and whether or not the frame is being transmitted by detecting the CRC bits of the received control message.

Referring to FIG. 7A, a despreader 711 despreads a received signal using a PN sequence and an orthogonal code to receive a dedicated control channel signal. A diversity combiner 713 combines the signals, received through multiple paths, output from the despreader 711. A soft decision generator 715 quantizes the received signal into a digital value of several levels to decode the received signal. A deinterleaver 717 deinterleaves the coded symbols interleaved during transmission to rearrange the symbols in the original state. Here, the deinterleaver 717 should be able to deinterleave both the 5ms frame and the 20ms frame, in order to deinterleave them in the same manner as the interleaver in the dedicated control channel transmission device. Therefore, as shown in FIG. 7B, it is also possible to use two deinterleavers. In FIG. 7B, a first deinterleaver 717 deinterleaves the interleaved frame data in the same manner as the 5ms frame interleaver of the dedicated control channel transmission device. Similarly, a second deinterleaver 718 deinterleaves the interleaved frame data in the same manner as the 20ms frame interleaver of the dedicated control channel transmission device.

A timer 719 generates a control signal for decoding the data received through

the dedicated control channel at fixed periods. Here, the timer 719 is a 5ms timer. A first decoder 721 is enabled by the control signal output from the timer 719 and decodes the deinterleaved data output from the first deinterleaver 717. The first decoder 721 decodes the first control message of 5ms. A second decoder 723 is enabled by the control signal output from the timer 719 and decodes the deinterleaved data output from the second deinterleaver 718. The second decoder 723 decodes the second control message of 20ms. A first CRC detector 725 receives an output of the first decoder 721 and checks the CRC for the 5ms frame. A second CRC detector 727 receives an output of the second decoder 723 and checks the CRC for the 20ms frame. Here, the first and second CRC detectors 725 and 727 output a true signal "1" or a false signal "0" as the result signal.

A frame decision block 729 analyzes the result signals output from the first and second CRC detectors 725 and 727 to decide the frame length of the control message received through the dedicated control channel. The frame decision block 729 generates a select signal sel1 for selecting the first decoder 721 when the first CRC detector 725 outputs the true signal, generates a select signal sel2 for selecting the second decoder 723 when the second CRC detector 727 outputs the true signal, and generates a DISABLE signal for shutting off the outputs of the first and second decoders 721 and 723 when the first and second CRC detectors 725 and 727 both generate the false signal.

A selector 731 selects the decoded data output from the first and second decoders 721 and 723 according to the output signals of the frame decision block 729. That is, the selector 731 selects the output of the first decoder 721 when the received frame is a 5ms frame, selects the output of the second decoder 723 when the received frame is a 20ms frame, and shuts off the outputs of both the first

second decoders 721 and 723 for the period in which the control message is not received.

A modem controller 733 stores the received control message of the decoded data output from the selector 731 in a control message buffer 735. The upper layer processor then reads and processes the control message stored in the control message buffer 735.

Now, operation of the dedicated control channel reception device will be described hereinbelow with reference to FIGs. 7A and 7B. The despreader 711 receives the control signal through the dedicated control channel, and despreads the received control signal with the PN sequence. The control signals received through the dedicated control channel are restored to the original control message by way of the reverse process of transmission.

Thereafter, in the base station and the mobile station, the first decoder 721 decodes the 5ms frames and the second decoder 723 decodes the 20ms frames to process the control message. The first and second CRC detectors 725 and 727 then perform CRC checking for the decoded data output from the first and second decoders 721 and 723, respectively, and output the result values to the frame decision block 729. The frame decision block 729 then decides the frame length of the received control message and whether the frame is being transmitted or not, according to the CRC check results.

When it is assumed that CRC5 denotes the CRC check result for the 5ms frame and CRC20 denotes the CRC check result for the 20ms frame, the frame decision block 729 will generate the select signals as shown in Table 4.

TABLE 4

CRC Detector		Frame decision block	Selector	Decision Results
CRC5	CRC20			
True	False	sel1	1st Decoder Selected	5ms Frame
False	True	sel2	2nd Decoder Selected	20ms Frame
False	False	DISABLE	Decoder Output Off	No Frame
True	True	X	X	X

As shown in Table 4, when CRC5 and CRC20 are both not detected (i.e., false), the frame data is not received, which corresponds to a duration where the transmission device does not transmit the control message in the discontinuous transmission mode. However, when CRC5 and CRC20 are both detected (i.e., true), a frame error occurs.

During transmission, the radio signal may include impulse noises due to other electronic equipments and the power line. In this case, the reception device of the mobile communication system may misconceive the noise components as to be the frame data. That is, there is a probability that the CRC detector will output a true signal as an output signal, even though the noise is received instead of the effective frame.

FIG. 8 illustrates a dedicated control channel reception device according to another embodiment of the present invention, which includes a frame detector for detecting an effective (or valid) frame of data when the transmission device of the mobile communication system discontinuously transmits the data of a single length

frame. FIG. 10 is a flowchart illustrating a method for detecting the valid frame in the frame detector 740 of the reception device of FIG. 8.

For the convenience of explanation, it is assumed that the size of the frame data transmitted from the transmission device is 5ms long and the number of the decoded symbols output from the decoder is 144.

In FIG. 10, a register b stores a symbol energy value obtained by squaring an output of a diversity combiner 713 shown in FIG. 8, a register S accumulates the energy values output from the register b, and a register n stores the accumulated number of the input symbols. That is, the register b stores the energy value of the input symbols, and the register S accumulates the energy values of the symbols according to the number of the symbols stored in the register n.

Referring to FIGs. 8 and 10, the received signal is despread in the despreader 711 and combined with the signals received through the multipath in the diversity combiner 713. A frame detector 740 then receives the combined signal output from the diversity combiner 713 and detects the valid frame by performing the procedure of FIG. 10, and outputs the true signal "1" or the false signal "0" according to the frame detection results.

Next, referring to FIG. 10, the frame detector 740 initializes the register S and the register n (S=0 and n=0) in step 1011. After initialization, if the diversity combiner 713 generates an output, the frame detector 740 calculates in step 1013 the symbol energy value by squiring the output of the diversity combiner 713 and stores the value in the register b. The frame detector 740 updates in step 1015 the registers S by adding the value of the register b to the previous value of the register

S and updates the number of the input symbols by increasing the value of the register n by one. After increasing the value of the register n, the frame detector 740 determined in step 1017 whether the value of the register n is 144. That is, since the 5ms frame data is composed of 144 symbols, it is determined in the step 1017 whether the symbols of the 5ms frame are completely received or not. When the value of the register n is smaller than 144 in step 1017, the frame detector 740 returns to step 1013 to repeat the procedure for detecting the energy value of the input symbols and accumulating the value of the register S, since reception of the 5ms frame data is not yet completed.

In the meantime, if the value of the register n becomes 144, the frame detector 740 senses complete reception of the 5ms frame data and compares in step 1019 the value accumulated at the register S with a threshold value. Here, the threshold value can be set to the minimum energy value of the 5ms valid frame, and can be used as a reference value for deciding whether the 5ms frame data is received or not. As the result of comparison, if the value of the register S is larger than the threshold value, the frame detector 740 proceeds to step 1021 to output the true signal to the frame decision block 730; if the value of the register S is smaller than the threshold value, the frame detector 740 advances to step 1023 to output the false signal to the frame decision block 730. When the false signal is applied to the frame decision block 730, the transmission device performs the discontinuous transmission mode to suppress transmission of the control message.

When the frame detector 740 generates the true signal or the false signal in accordance with the procedure of FIG. 10, the frame decision block 730 generates the control signal for selecting the frame length by performing the procedure shown in FIG. 12. FIG. 12 is a flowchart illustrating a method for deciding the length and

presence of the frame in the frame decision block 730 of FIG. 8.

Referring to FIG. 12, the frame decision block 730 determines in step 1211 whether the frame detector 740 outputs the true signal. When a frame decision true signal is received, the frame decision block 730 checks in step 1213 whether the true signal is received from the CRC detector 725. If the true signal is received from the CRC detector 725 in step 1213, the frame decision block 730 generates an ENABLE signal to the selector 731 in step 1215, and then terminates the procedure. However, if the frame detection true signal is not received in step 1211, the frame decision block 730 generates the DISABLE signal to the selector 731 and terminates the procedure. In addition, when the signal output from the CRC detector 725 is not the true signal in step 1213, the frame decision block 730 generates the DISABLE signal to the selector 731 and terminates the procedure. Here, the frame decision block 730 can decide whether the frame data is received or not, depending on only the output of the frame detector 740.

The selector 731 then selects the output of the decoder 721 to provide it to the modem controller 733 or controls (shuts off) transmission of the output of the decoder 721, according to the ENABLE or DISABLE signal output from the frame decision block 730.

The descriptions of FIGs. 8, 10 and 12 are given on the assumption that the received frame is 5ms frame. However, the frame detection and decision method stated above can be also applied to a frame having a different length, in the same manner. That is, for the case of the 20ms frame, the deinterleaver 717, the decoder 721 and the CRC detector 725 of FIG. 8 are modified to receive and process the 20ms frame, and the frame detector 740 detects the frame according to the

procedure shown in FIG. 11. That is, for the case of the 20ms frame, the number of the symbols output from the encoder of the transmission device is 576, so that the frame detector 740 accumulates the energy value of the symbols received during the 576 symbol duration and compares the accumulated value with the threshold value to determine whether the frame is detected or not. Here, the threshold value for the 20ms frame can be set to the minimum energy value of the 20ms valid frame, and can be used as a reference value for determining whether the 20ms frame data is received or not.

Shown in Table 5 are decision results of the frame decision block 730 with respect to the output signals of the frame detector 740 and the CRC detector 725, based on the procedure of FIG. 12.

TABLE 5

Frame Detector	CRC Detector	Frame Determiner	Selector	Decision Results
False	False	Disable	Decoder Output Off	No Frame
False	True	Disable	Decoder Output Off	Error Frame
True	False	Disable	Decoder Output Off	Error Frame
True	True	Enable	Decoder Output On	Frame Received

In Table 5, when the outputs of the frame detector 740 and the CRC detector 725 are both not the true signals, the frame decision block 730 decides that the message frame is not transmitted from the transmission device ("No Frame") or that the frame has an error ("Error Frame"). In the embodiment, when the outputs of the

frame detector 740 and the CRC detector 725 are both the false signals, the frame decision block 730 decides that transmission device does not transmit the message frame; when one of the outputs of the frame detector 740 and the CRC detector 725 is the false signal, the frame decision block 730 decides that the corresponding message frame is an error frame.

FIG. 9 illustrates a reception device according to another embodiment of the present invention, which includes two frame detectors for detecting the frames having two different lengths. FIG. 11 is a flowchart illustrating a method for detecting the valid frame in a second frame detector 741 of FIG. 9.

In the following description, it is assumed that the first and second frames are 5ms and 20ms long, respectively. Further, the first frame of 5ms and the second frame of 20ms are composed of 144 symbols and 576 symbols, respectively.

Referring to FIG. 9, the reception device includes a first frame detector 743 and the second frame detector 741, to receive the frames having different lengths. The remaining structures are the same as those shown in FIG. 8. In FIG. 9, the first frame detector 743 is a 5ms frame detector and the second frame detector 741 is a 20ms frame detector. The first frame detector 743 performs the same operation as the frame detector 740 of FIG. 8, as shown in FIG. 10.

Likewise, the second frame detector 741 receives the output of the diversity combiner 713, detects the valid second frame according to the procedure of FIG. 11 and outputs the true or false signals according to the detection results. Referring to FIG. 11, steps 1111 to 1115 are identical to the steps 1011 to 1015 of FIG. 10. However, the second frame detector 741 repeats the steps 1113 and 1115 until the

value of the register n becomes 576 in step 1117. Thereafter, in step 1119, the second frame detector 741 compares the accumulated value of the register S with the threshold value to determine whether the accumulated value of the register S is larger than the threshold value. As the result of comparison, if the value of the register S is larger than the threshold value, the second frame detector 741 outputs the true signal to the frame decision block 750, in step 1121; if the value of the register S is smaller than the threshold value, the second frame detector 741 proceeds to step 1123 and outputs the false signal to the fame length decision block 750.

Upon reception of the true or false signal from the first and second frame detectors 743 and 741, the frame decision block 750 performs the procedure of FIG. 13. FIG. 13 is a flowchart illustrating a method for determining the frame length in the frame decision block 750 of FIG. 9.

Referring to FIG. 13, the frame decision block 750 examines in step 1311 whether the frame detection true signal is received from the first and the second frame detectors 743 and 741. If the frame detection true signal is received, the frame decision block 750 judges in step 1313 whether the frame detection true signals are received from both the first and second frame detectors 743 and 741. As the result of judgement, if the frame detection true signals are received from both the first and second frame detectors 743 and 741, the frame decision block 750 examines in step 1315 whether the first CRC detector 725 outputs the true signal. When the true signal is input from the first CRC detector 725, the frame decision block 750 advances to step 1317 to determine whether the second CRC detector 727 outputs the true signal. When the true signals are input from both the first and second CRC detectors 725 and 727, the frame decision block 750 generates the select signal sel2

to the selector 731 in step 1319, so that the selector 731 selects the frame output from the second decoder 723 and provides the selected frame to the modem controller 733.

However, when the signal output from the first CRC detector 725 is not the true signal in step 1315, the frame decision block 750 examines in step 1321 whether the signal output from the second CRC detector 727 is the true signal. As the result of examination, if the input signal is the true signal, the frame decision block 750 goes to the step 1319 and generates the select signal sel2 to the selector 731. The selector 731 then selects the output of the second decoder 723 in response to the select signal sel2 and outputs the selected signal to the modem controller 733. However, when the output signal of the second CRC detector 727 is the false signal in the step 1321, the selector 731 outputs the DISABLE signal and terminates the procedure. The selector 731 then selects none of the outputs of first and second decoders 721 and 723. Thus, there is no data delivered to the modem controller 733.

In addition, when the true signal is input from only one of the first and second frame detectors 743 and 741 in step 1313, the frame decision block 750 judges in steps 1323 and 1329 whether the input signal is received from the first frame detector 743 or the second frame detector 741. As the result of judgement, if the true signal is received from the first frame detector 743, the frame decision block 750 examines in step 1325 whether the first CRC detector 725 outputs the true signal. When the signal output from the first CRC detector 725 is the true signal, the frame decision block 750 generates the select signal sel1 to the selector 731, in step 1327. However, when the false signal is output from the first CRC detector 725, the frame decision block 750 generates the DISABLE signal. The selector 731 then selects the first frame output from the first decoder 721 to provide

it to the modem controller 733 in response to the select signal sel1, and shuts off the outputs of the first and second decoders 721 and 723 in response to the DISABLE signal.

Moreover, the frame decision block 750 determines in step 1329 whether the input true signal is received from the second frame detector 741. If so, the frame decision block 750 determines in step 1311 whether the second CRC detector 727 outputs the true signal. When the second CRC detector 727 outputs the true signal, the frame decision block 750 proceeds to step 1319 and generates the select signal sel2 to the selector 731. However, when the second CRC detector 727 outputs the false signal, the frame decision block 750 outputs the DISABLE signal to the selector 731. The selector 731 then selects the second frame output from the second decoder 723 to provide it to the modem controller 733 in response to the select signal sel2, and shuts off the outputs of the first and second decoders 721 and 723 in response to the DISABLE signal.

Shown in Table 6 are output signals of the frame detectors 741 and 743, the CRC detectors 725 and 727, and the frame decision block 750 in accordance with the procedure of FIG. 13.

TABLE 6

1st Frame Detector	2nd Frame Detector	CRC Detector		Frame Determiner	Selector	Decision Results
		CRC5	CRC20			
False	False	X	X	DISABLE	Decoder Output Off	False Frame

True	False	False	X	DISABLE	Decoder Output Off	False Frame
True	False	True	X	sel1	1st Decoder Selected	5ms Frame
False	True	X	True	sel2	2nd Decoder Selected	20ms Frame
False	True	X	False	DISABLE	Decoder Output Off	False Frame
True	True	X	True	sel2	2nd Decoder Selected	20ms Frame
True	True	True	False	sel1	1st Decoder Selected	5ms Frame
True	True	True	False	DISABLE	Decoder Output Off	False Frame

In Table 6, the "False Frame" means that the transmission device does not transmit the message frame (i.e., "No Frame") or the frame has an error during transmission (i.e., "Error Frame"). In case of "False Frame", the frame decision block 750 examines the outputs of the frame detectors 741 and 743 and the CRC detectors 725 and 727 to determine whether "False Frame" corresponds to "No Frame" or "Error Frame". In the embodiment, the frame decision block 750 outputs the decision results according to the outputs of the frame detectors 741 and 743 and the CRC detectors 725 and 727, as shown in Table 7.

TABLE 7

1st Frame Detector	2nd Frame Detector	CRC Detector		Frame Determiner	Selector	Decision Results
		CRC5	CRC20			
False	False	X	X	DISABLE	Decoder Output Off	No Frame
True	False	False	X	DISABLE	Decoder Output Off	Error Frame
True	False	True	X	sel1	1st Decoder Selected	5ms Frame
False	True	X	True	sel2	2nd Decoder Selected	20ms Frame
False	True	X	False	DISABLE	Decoder Output Off	Error Frame
True	True	X	True	sel2	2nd Decoder Selected	20ms Frame
True	True	True	False	sel1	1st Decoder Selected	5ms Frame
True	True	True	False	DISABLE	Decoder Output Off	Error Frame

The outputs of the frame decision block 750 are delivered to the modem controller 733, as illustrated in FIG. 14.

Referring to FIG. 14, when the frame decision block 750 generates the select signal sel1 or sel2, the selector 731 selects the decoded message for the frame corresponding to the select signal and outputs the selected message to the modem controller 733. The modem controller 733 then delivers the received message to the upper processor. However, when the frame decision block 750 generates the DISABLE signal, the selector 731 blocks the output path for the decoded message. In this case, the modem controller 733 examines a frame decision signal output from the frame decision block 750. When the frame decision signal represents "No Frame", the modem controller 733 does not deliver the decision result to the upper layer on the judgement that there is no message transmitted from the transmission device. However, when the frame decision signal represents "Error Frame", the modem controller 733 delivers the decision result to the upper processor on the judgment that the transmission device has transmitted a message but the message has an error during transmission. Therefore, the upper processor may take a proper action on the error frame.

FIG. 15 illustrates a simulation result for processing control messages having a variable frame length through the dedicated control channel according to the present invention. Referring to FIG. 15, shown is a comparison result between the throughputs when the 5ms frame is used and when the 20ms frame is used for the dedicated control channel. Here, the forward packet traffic channel has a data rate 307.2Kbps, the 20ms fixed frame and 1% FER (Frame Error Rate).

As described above, the DCMA mobile communication system according to the present invention has the following advantages:

(1) The control message transmitted to the dedicated control channel has a different length according to the size of the control message, so that the throughput

may be increased and the traffic delay may be decreased by utilization of the dedicated control channel;

(2) Use of the dedicated control channel is discontinuously controlled according to presence/absence of the control message to transmit. Thus, the radio capacity may be increased by the DTX mode transmission;

(3) The system provides reliable transmission through faster error detection and correction, as compared with the IS-95 system. Further, the system effectively uses the radio resources through utilization of an optimal channel environment and can provide the improved voice service through the dedicated control channel, so that it is possible to effectively support the IS-95 message; and

(4) In the CDMA mobile communication system, it is possible to reduce the probability of receiving the error frames by using both the energy measurement result for the frame and the error detection result.

While the invention has been shown and described with reference to a certain preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

WHAT IS CLAIMED IS:

1. A CDMA (Code Division Multiple Access) system for transmitting messages having at least two different frame lengths, comprising:

a controller for determining a frame length of a message to be transmitted and outputting a frame select signal corresponding to the determined frame length;

at least one message generator for generating frame data of the message to be transmitted according to the frame select signal; and

a transmitter for spreading the frame data and transmitting the spread frame data through a dedicated control channel.

2. The CDMA system as claimed in claim 1, wherein the message generator comprises:

a CRC (Cyclic Redundance Check) generator for generating CRC bits for the message in the frame length determined according to the frame select signal and adding the CRC bits to the message;

a tail bit generator for generating tail bits and adding the generated tail bits to an output of the CRC generator;

a channel encoder for encoding the tail bit-added frame data with a predetermined encoding rate; and

an interleaver for interleaving the encoded message by a unit of the frame length determined according to the frame select signal.

3. The CDMA system as claimed in claim 1, wherein the message frame includes a 5ms frame and a 20ms frame.

4. The CDMA system as claimed in claim 1, wherein the message

includes a user message, a signaling message and a MAC (Medium Access Control) message.

5. The CDMA system as claimed in claim 1, wherein the dedicated control channel transmission device includes the message generators as many as the number of the frame lengths of the message to be transmitted and the respective message generators generate the frame data in the corresponding frame length,

wherein each of the message generators comprises;

a CRC generator for generating CRC bits for the message to be transmitted and adding the CRC bits to the message;

a tail bit generator for generating tail bits and adding the generated tail bits to an output of the CRC generator;

a channel encoder for encoding the tail bit-added frame data with a predetermined encoding rate; and

an interleaver for interleaving the encoded message by a unit of the frame length determined according to the frame select signal.

6. The CDMA system as claimed in claim 1, wherein the controller comprises a device for generating an output control signal to perform a discontinuous transmission mode when there is no message to transmit, wherein the transmitter comprises a path controller for controlling an output of the dedicated control channel in response to the output control signal.

7. The CDMA system as claimed in claim 6, wherein the transmitter comprises:

the path controller for receiving the frame data to be transmitted and blocking up an output path of the frame data in response to the output control

signal;

an orthogonal spreader for spreading the message frame output from the path controller with an orthogonal code for the dedicated control channel; and

a PN (Pseudo Noise) spreader for spreading the orthogonally spread signal with a PN sequence.

8. The CDMA system as claimed in claim 7, wherein the path controller comprises a gain controller whose output gain becomes zero in response to the output control signal.

9. A method for transmitting messages having at least two different frame lengths in a CDMA communication system, comprising the steps of:

determining a frame length of a message to be transmitted and outputting a frame select signal corresponding to the determined frame length, so as to transmit the message having at least two different frame lengths;

generating frame data of the message to be transmitted according to the frame select signal; and

spreading the frame data and transmitting the spread frame data through a dedicated control channel.

10. The method as claimed in claim 9, wherein the frame data generating step comprises the steps of:

generating CRC bits for the message to be transmitted and adding the CRC bits to the message;

generating tail bits and adding the generated tail bits to the CRC bit-added message;

encoding the tail bit-added frame data with a predetermined encoding rate;

and

interleaving the encoded message by a unit of the frame length determined according to the frame select signal.

11. The method as claimed in claim 9, wherein the message frame includes a 5ms frame and a 20ms frame.

12. The method as claimed in claim 9, wherein the message includes a user message, a signaling message and a MAC message.

13. The method as claimed in claim 9, further comprising the step of performing a discontinuous transmission mode to control an output of the dedicated control channel when there is no message to transmit.

14. The method as claimed in claim 13, wherein a transmission gain for the message is zero in the discontinuous transmission mode.

15. A CDMA system for receiving messages having at least two different frame lengths, comprising:

a despreader for despreading a signal received through a dedicated control channel;

a first message receiver for deinterleaving and decoding the despread signal in a first frame length to output a first message, and detecting a first CRC corresponding to the decoded signal;

a second message receiver for deinterleaving and decoding the despread signal in a second frame length to output a second message, and detecting a second CRC corresponding to the decoded signal; and

a controller for selecting one of the first and second messages according to first and second CRC detection results by the first and second message receivers.

16. The CDMA system as claimed in claim 15, wherein the controller comprises:

a frame decider for analyzing the first and second CRC detection results to decide a frame length of the received message and output a frame length decision signal; and

a selector for selecting one of the decoded signals output from the first and second message receivers according to the frame decision signal.

17. The CDMA system as claimed in claim 15, wherein the first and second frame lengths are 5ms and 20ms long, respectively.

18. A CDMA system for receiving messages having at least two different frame lengths, comprising:

a despreader for despreading a signal received through a dedicated control channel;

a frame detector for detecting an energy of the despread signal in first and second frame lengths and outputting first and second frame detection signals according to the detection results;

a first message receiver for deinterleaving and decoding the despread signal in the first frame length to output a first message;

a second message receiver for deinterleaving and decoding the despread signal in the second frame length to output a second message; and

a controller for selecting one of the first and second messages according to the first and second detection results.

19. The CDMA system as claimed in claim 18, wherein the controller comprises:

a frame decider for analyzing the first and second frame detection results to decide a frame length of the received message and output a frame length decision signal; and

a selector for selecting one of the decoded signals output from the first and second message receivers according to the frame decision signal.

20. The CDMA system as claimed in claim 18, wherein the first and second frame lengths are 5ms and 20ms long, respectively.

21. The CDMA system as claimed in claim 20, wherein the frame detector comprises first and second frame detectors;

wherein the first frame detector has as a reference value a minimum energy value of a 5ms effective frame and compares an energy value of the received frame message with the minimum energy value of the 5ms effective frame to generate a first frame detection signal when the energy value of the received frame message is higher than the minimum energy value of the 5ms effective frame;

wherein the second frame detector has as a reference value a minimum energy value of a 20ms effective frame and compares an energy value of the received frame message with the minimum energy value of the 20ms effective frame to generate a second frame detection signal when the energy value of the received frame message is higher than the minimum energy value of the 20ms effective frame.

22. A CDMA system for receiving messages having at least two different frame lengths, comprising:

a despreader for despreading a signal received through a dedicated control channel;

a first frame detector for detecting an energy of the despread signal in a first frame length to output a first frame detection signal according to the detection result;

a second frame detector for detecting an energy of the despread signal in a second frame length to output a second frame detection signal according to the detection result;

a first message receiver for deinterleaving and decoding the despread signal in the first frame length to output a first message and detecting a first CRC corresponding to the decoded signal to output a first CRC detection signal;

a second message receiver for deinterleaving and decoding the despread signal in the second frame length to output a second message and detecting a second CRC corresponding to the decoded signal to output a second CRC detection signal; and

a controller for selecting one of the first and second messages according to the first and second frame detection results and the first and second CRC detection results.

23. The CDMA system as claimed in claim 22, wherein the first and second frame lengths are 5ms and 20ms long, respectively.

24. TheCDMA system as claimed in claim 23, wherein the controller comprises:

a frame decider for analyzing the first and second CRC detection signals and the first and second frame detection signals, judging the received frame to have the second frame length when the second CRC detection signal and the second frame

detection signal are received, judging the received frame to have the first frame length when the first CRC detection signal and the first frame detection signal are received, and judging the received frame to be an error frame when other CRC and frame detection signals are received; and

a selector for outputting a corresponding one of the decoded signals output from the first and second message receivers upon receiving one of first and second frame length decision signals, and controlling an output of the decoded signal upon reception of an error frame decision signal.

25. The CDMA system as claimed in claim 24, wherein the frame decider judges that no frame is received when none of the first and second frame detection signals and none of the first and second CRC detection signals are received.

26. The CDMA system as claimed in claim 23, wherein the frame detector comprises first and second frame detectors;

wherein the first frame detector has as a reference value a minimum energy value of a 5ms effective frame and compares an energy value of the received frame message with the minimum energy value of the 5ms effective frame to generate a first frame detection signal when the energy value of the received frame message is higher than the minimum energy value of the 5ms effective frame;

wherein the second frame detector has as a reference value a minimum energy value of a 20ms effective frame and compares an energy value of the received frame message with the minimum energy value of the 20ms effective frame to generate a second frame detection signal when the energy value of the received frame message is higher than the minimum energy value of the 20ms effective frame.

27. A method for receiving messages having at least two different frame lengths in a CDMA communication system, comprising the steps of:

despreading a signal received through a dedicated control channel;

deinterleaving and decoding the despread signal in a first frame length to output a first message, and detecting a first CRC corresponding to the decoded signal;

deinterleaving and decoding the despread signal in a second frame length to output a second message, and detecting a second CRC corresponding to the decoded signal; and

selecting one of the first and second messages according to the first and second CRC detection results.

28. A method for receiving messages having at least two different frame lengths in a CDMA communication system, comprising the steps of:

despreading a signal received through a dedicated control channel;

detecting an energy of the despread signal in first and second frame lengths and outputting first and second frame detection signals according to the detection results;

deinterleaving and decoding the despread signal in the first and second frame lengths to output first and second messages; and

selecting one of the first and second messages according to the first and second frame detection results.

29. A method for receiving messages having at least two different frame lengths in a CDMA communication system, comprising the steps of:

despreading a signal received through a dedicated control channel;

detecting an energy of the despread signal in a first frame length to output

a first frame detection signal according to the detection result;

detecting an energy of the despread signal in a second frame length to output a second frame detection signal according to the detection result;

deinterleaving and decoding the despread signal in the first frame length to output a first message and detecting a first CRC corresponding to the decoded signal;

deinterleaving and decoding the despread signal in the second frame length to output a second message and detecting a second CRC corresponding to the decoded signal; and

selecting one of the first and second messages according to the first and second frame detection results and the first and second CRC detection results.

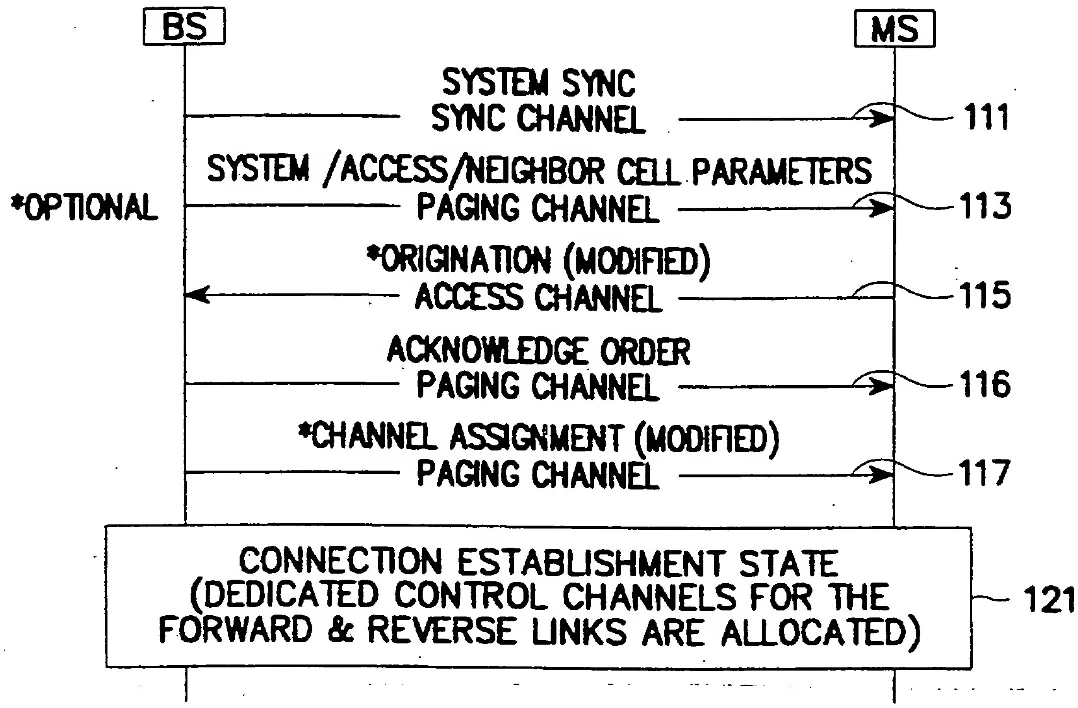

BS
MS
SYSTEM SYNC
SYNC CHANNEL
111
SYSTEM /ACCESS/NEIGHBOR CELL PARAMETERS
*OPTIONAL
PAGING CHANNEL
113
*ORIGINATION (MODIFIED)
ACCESS CHANNEL
115
ACKNOWLEDGE ORDER
PAGING CHANNEL
116
*CHANNEL ASSIGNMENT (MODIFIED)
PAGING CHANNEL
117
CONNECTION ESTABLISHMENT STATE
(DEDICATED CONTROL CHANNELS FOR THE
FORWARD & REVERSE LINKS ARE ALLOCATED)
121

FIG. 1A

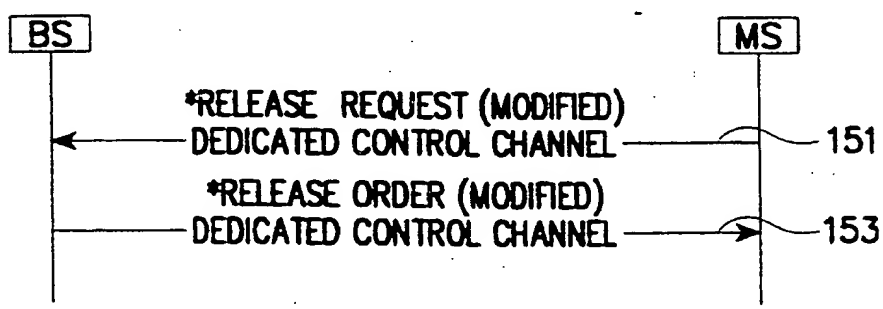

BS
MS
*RELEASE REQUEST (MODIFIED)
DEDICATED CONTROL CHANNEL
151
*RELEASE ORDER (MODIFIED)
DEDICATED CONTROL CHANNEL
153

FIG. 1B

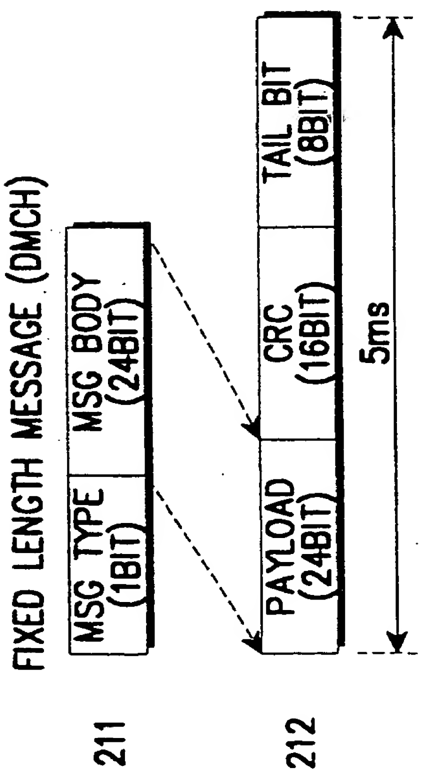

FIXED LENGTH MESSAGE (DMCH)
211
MSG TYPE (1BIT)
MSG BODY (24BIT)
212
PAYLOAD (24BIT)
CRC (16BIT)
TAIL BIT (8BIT)
5ms

FIG. 2A

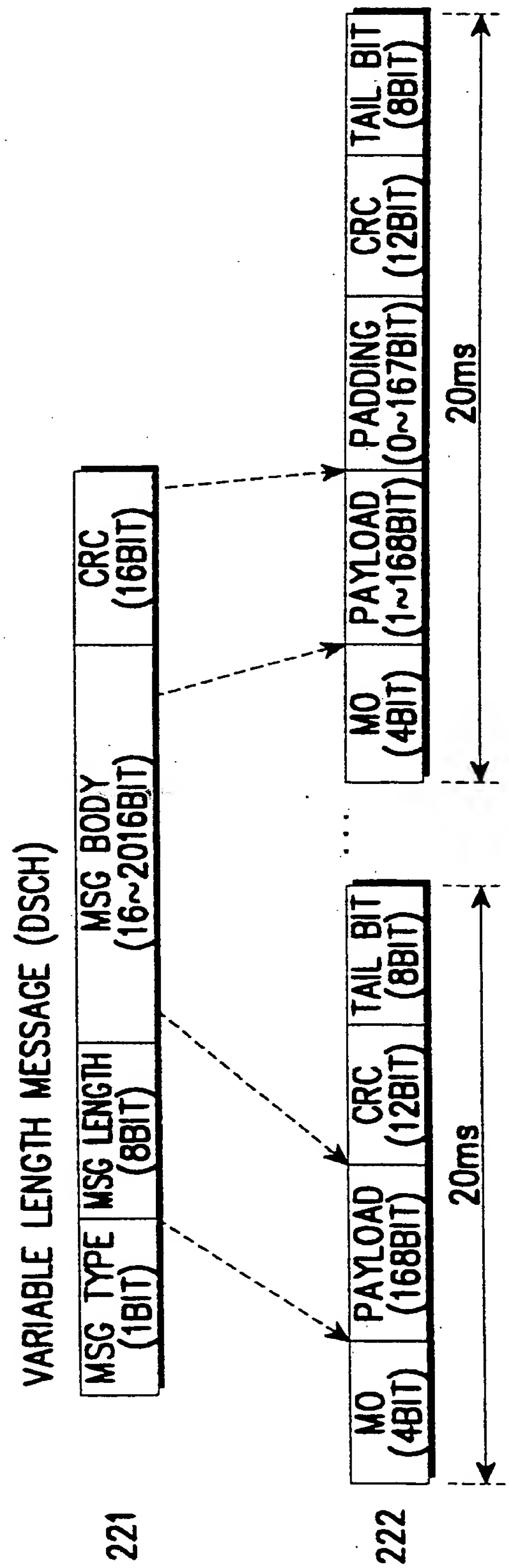
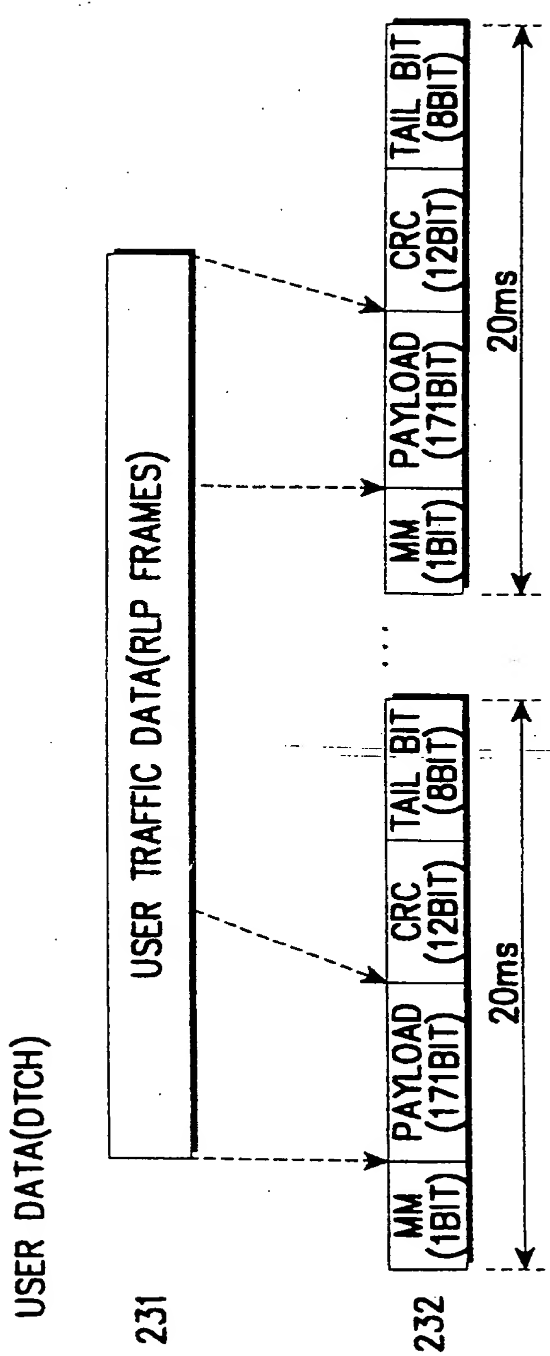

VARIABLE LENGTH MESSAGE (DSCH)
221
MSG TYPE (1BIT)
MSG LENGTH (8BIT)
MSG BODY (16~2016BIT)
CRC (16BIT)
222
MO (4BIT)
PAYLOAD (168BIT)
CRC (12BIT)
TAIL BIT (8BIT)
20ms
MO (4BIT)
PAYLOAD (1~168BIT)
PADDING (0~167BIT)
CRC (12BIT)
TAIL BIT (8BIT)
20ms

FIG. 2B



USER DATA(DTCH)
231
USER TRAFFIC DATA(RLP FRAMES)
232
MM (1BIT)
PAYLOAD (171BIT)
CRC (12BIT)
TAIL BIT (8BIT)
20ms
MM (1BIT)
PAYLOAD (171BIT)
CRC (12BIT)
TAIL BIT (8BIT)
20ms

FIG. 2C

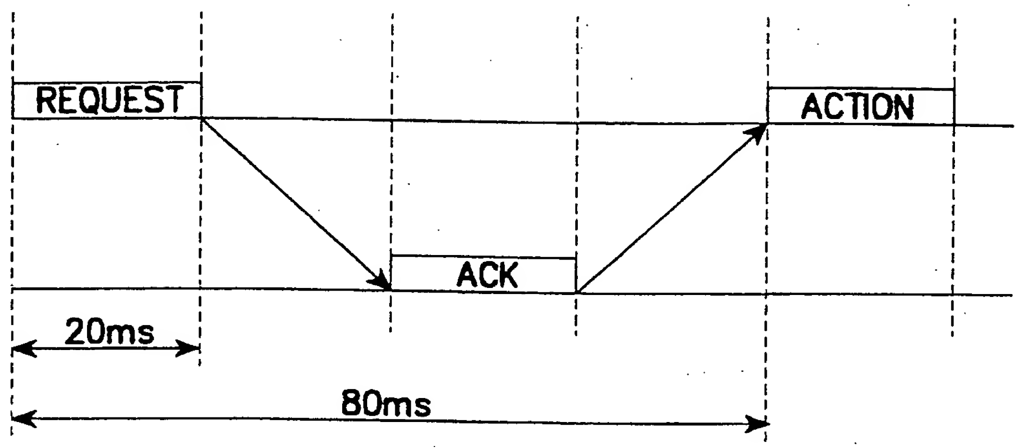


FIG. 3A

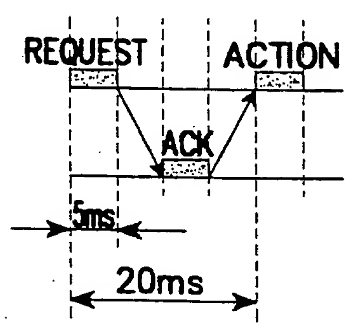


FIG. 3B

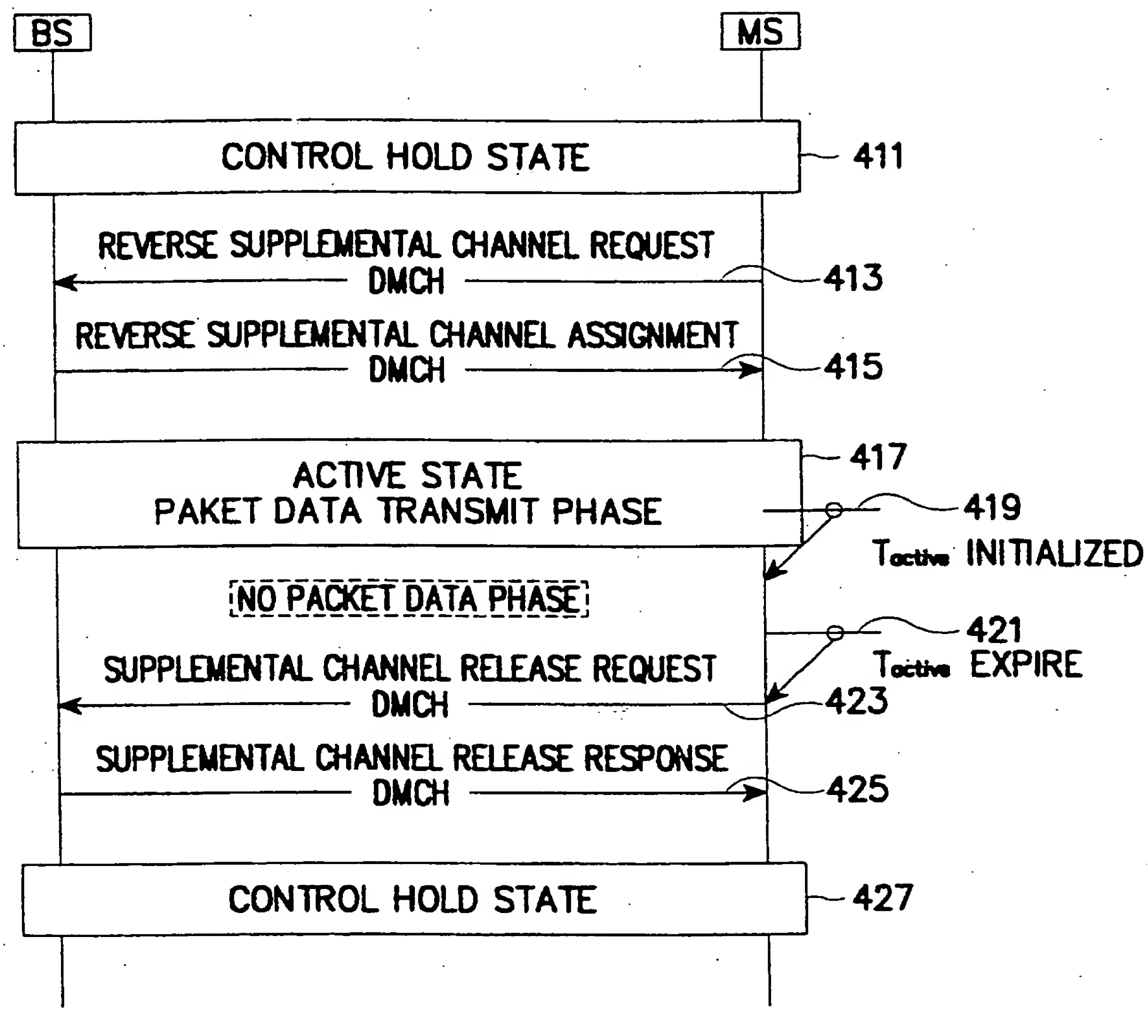

BS
MS
CONTROL HOLD STATE
411
REVERSE SUPPLEMENTAL CHANNEL REQUEST
DMCH
413
REVERSE SUPPLEMENTAL CHANNEL ASSIGNMENT
DMCH
415
ACTIVE STATE
PAKET DATA TRANSMIT PHASE
417
419
Tactive INITIALIZED
NO PACKET DATA PHASE
421
Tactive EXPIRE
SUPPLEMENTAL CHANNEL RELEASE REQUEST
DMCH
423
SUPPLEMENTAL CHANNEL RELEASE RESPONSE
DMCH
425
CONTROL HOLD STATE
427

FIG. 4

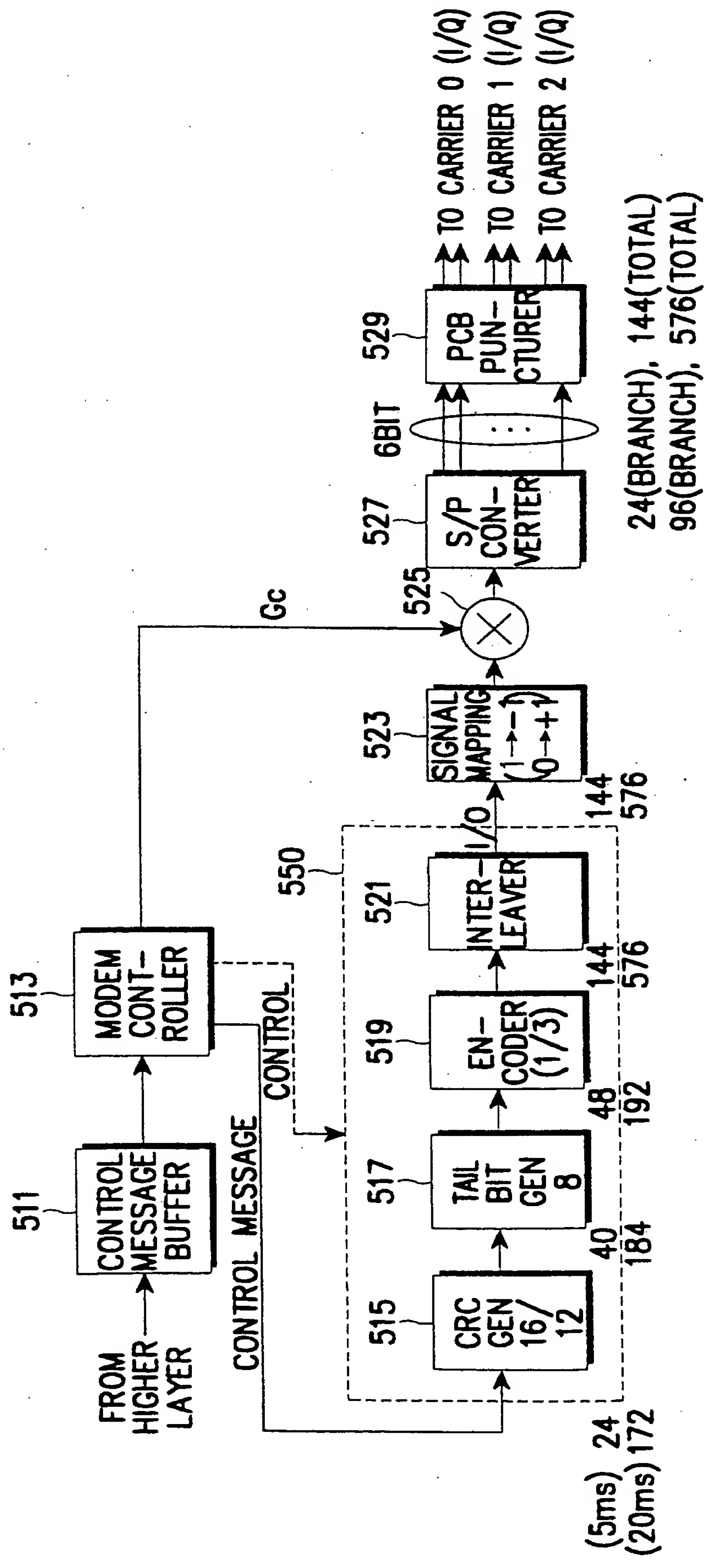

FROM HIGHER LAYER
511
CONTROL MESSAGE BUFFER
513
MODEM CONT-ROLLER
CONTROL MESSAGE
CONTROL
Gc
550
515
CRC GEN 16/12
517
TAIL BIT GEN 8
519
EN-CODER (1/3)
521
INTER-LEAVER
I/Q
523
SIGNAL MAPPING (1→-1 0→+1)
525
527
S/P CON-VERTER
6BIT
529
PCB PUN-CTURER
TO CARRIER 0 (I/Q)
TO CARRIER 1 (I/Q)
TO CARRIER 2 (I/Q)
(5ms) 24
(20ms) 172
40
184
48
192
144
576
144
576
24(BRANCH), 144(TOTAL)
96(BRANCH), 576(TOTAL)

FIG. 5A

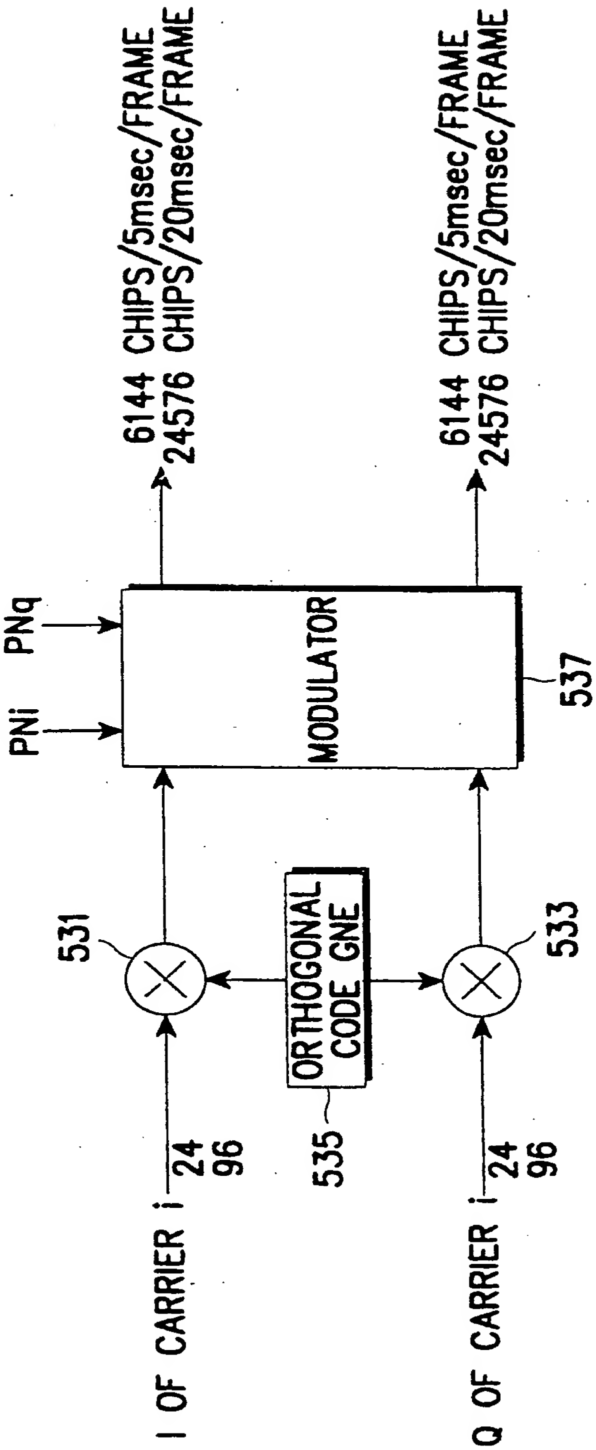

I OF CARRIER i
24
96
531
ORTHOGONAL CODE GNE
535
Q OF CARRIER i
24
96
533
PNi
PNq
MODULATOR
537
6144 CHIPS/5msec/FRAME
24576 CHIPS/20msec/FRAME
6144 CHIPS/5msec/FRAME
24576 CHIPS/20msec/FRAME

FIG. 5B

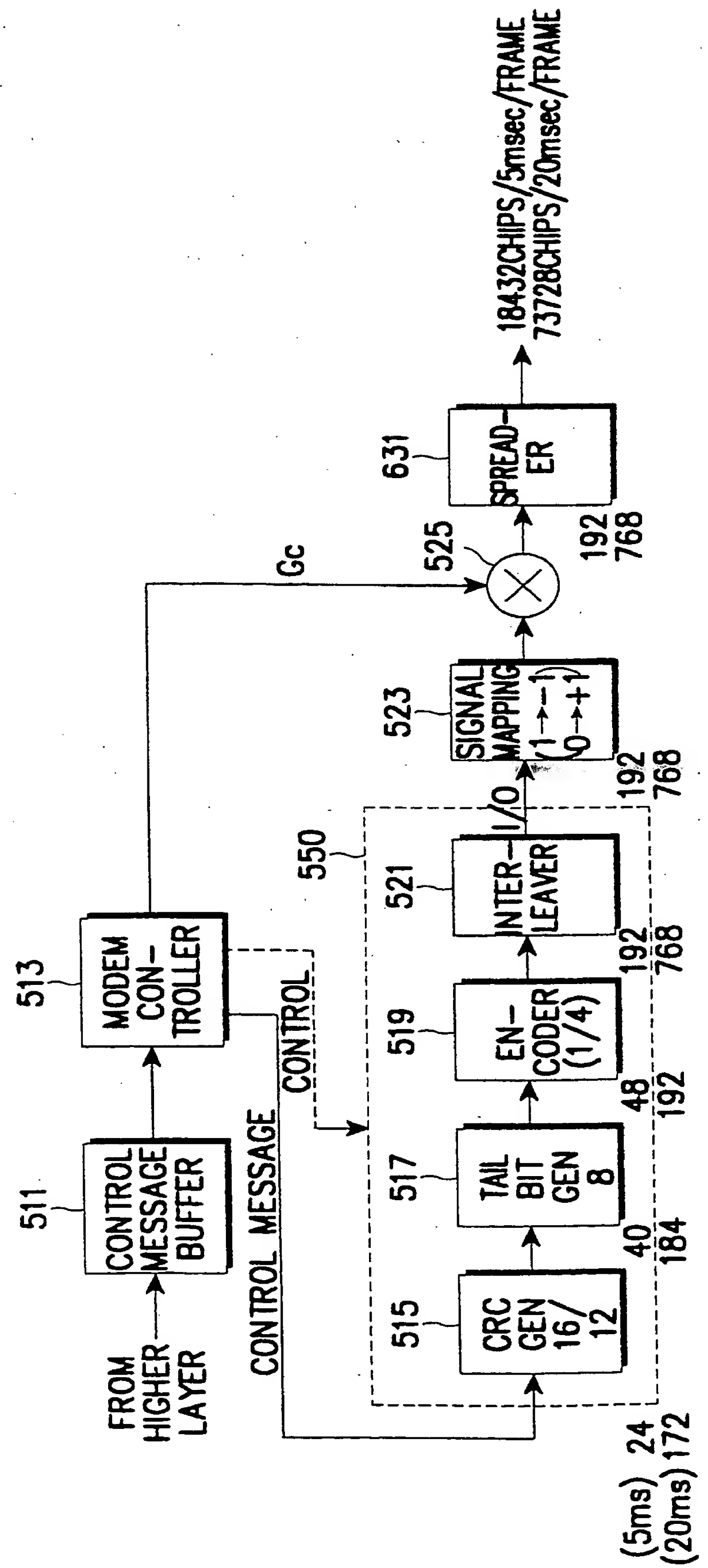

18432CHIPS/5msec/FRAME
73728CHIPS/20msec/FRAME
631
SPREAD-ER
192
768
525
Gc
523
SIGNAL MAPPING (1→-1) (0→+1)
I/O
550
521
INTER-LEAVER
519
EN-CODER (1/4)
517
TAIL BIT GEN 8
48
192
515
CRC GEN 16/12
40
184
(5ms) 24
(20ms) 172
513
MODEM CON-TROLLER
CONTROL
511
CONTROL MESSAGE BUFFER
FROM HIGHER LAYER
CONTROL MESSAGE

FIG. 6

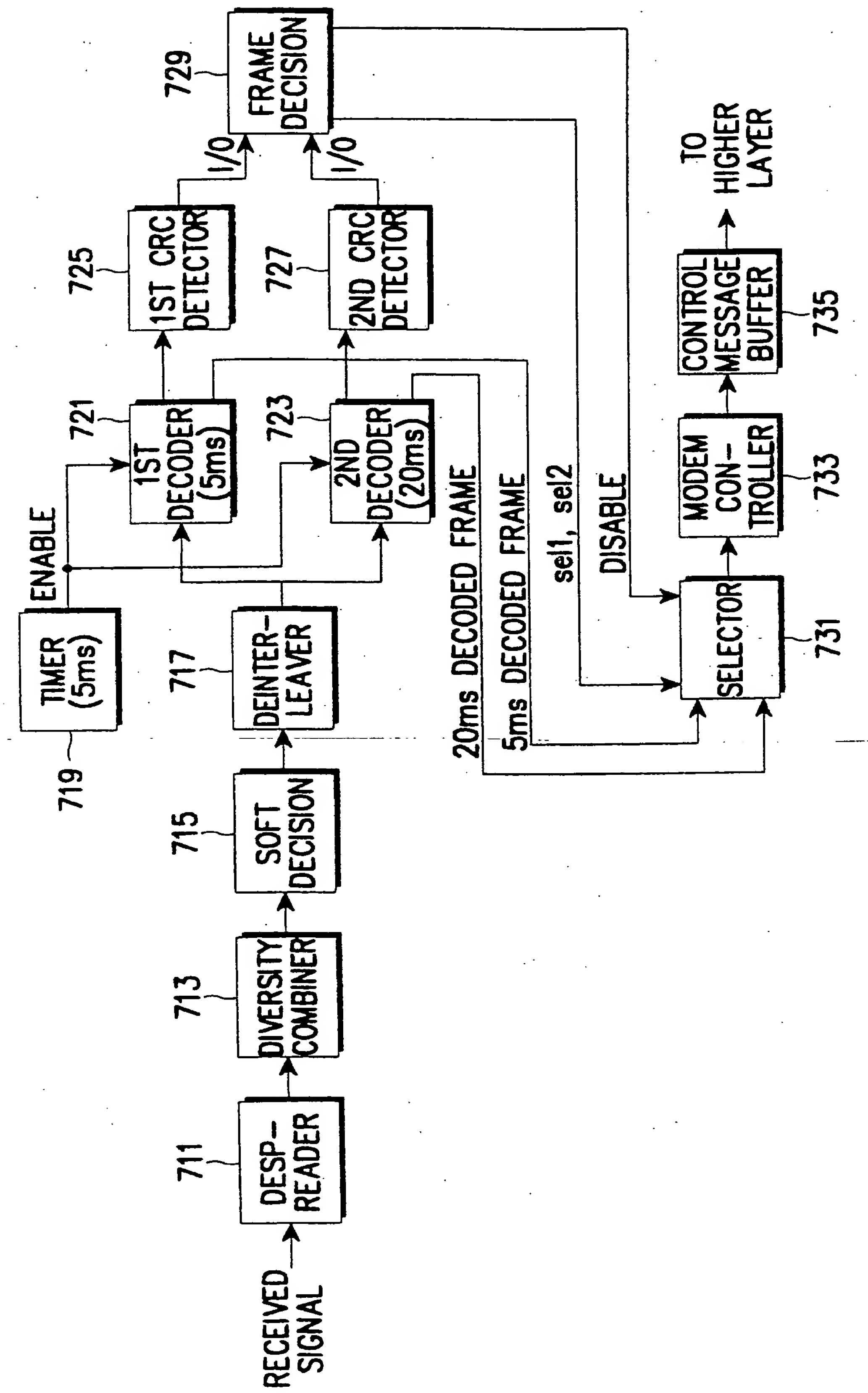

RECEIVED SIGNAL
711
DESP-READER
713
DIVERSITY COMBINER
715
SOFT DECISION
717
DEINTER-LEAVER
719
TIMER (5ms)
ENABLE
721
1ST DECODER (5ms)
723
2ND DECODER (20ms)
725
1ST CRC DETECTOR
727
2ND CRC DETECTOR
I/O
I/O
729
FRAME DECISION
20ms DECODED FRAME
5ms DECODED FRAME
sel1, sel2
DISABLE
731
SELECTOR
733
MODEM CON-TROLLER
735
CONTROL MESSAGE BUFFER
TO HIGHER LAYER

FIG. 7A

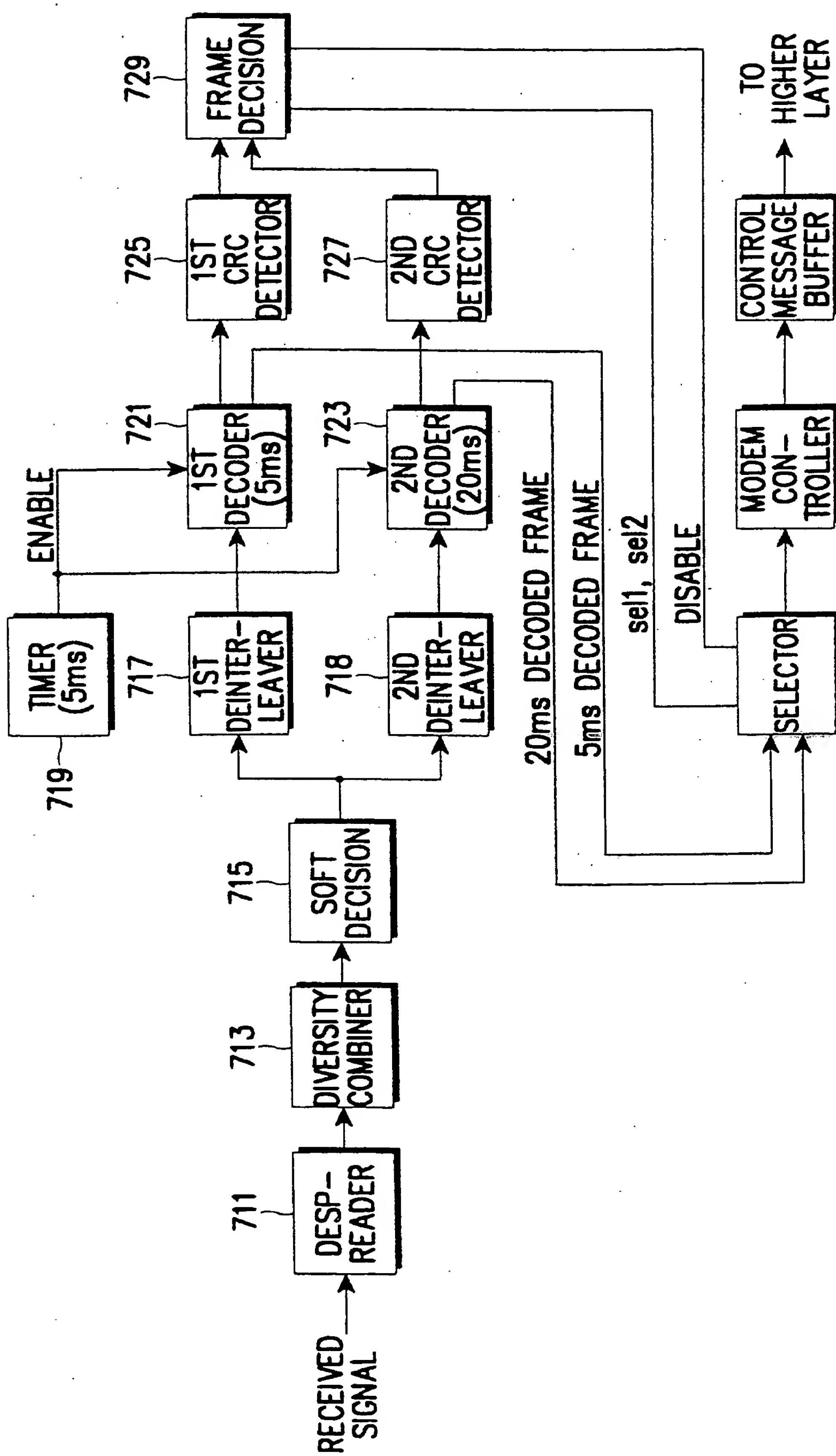

RECEIVED SIGNAL
711
DESP-READER
713
DIVERSITY COMBINER
715
SOFT DECISION
719
TIMER (5ms)
ENABLE
717
1ST DEINTER-LEAVER
718
2ND DEINTER-LEAVER
721
1ST DECODER (5ms)
723
2ND DECODER (20ms)
725
1ST CRC DETECTOR
727
2ND CRC DETECTOR
729
FRAME DECISION
20ms DECODED FRAME
5ms DECODED FRAME
sel1, sel2
DISABLE
731
SELECTOR
733
MODEM CON-TROLLER
735
CONTROL MESSAGE BUFFER
TO HIGHER LAYER

FIG. 7B

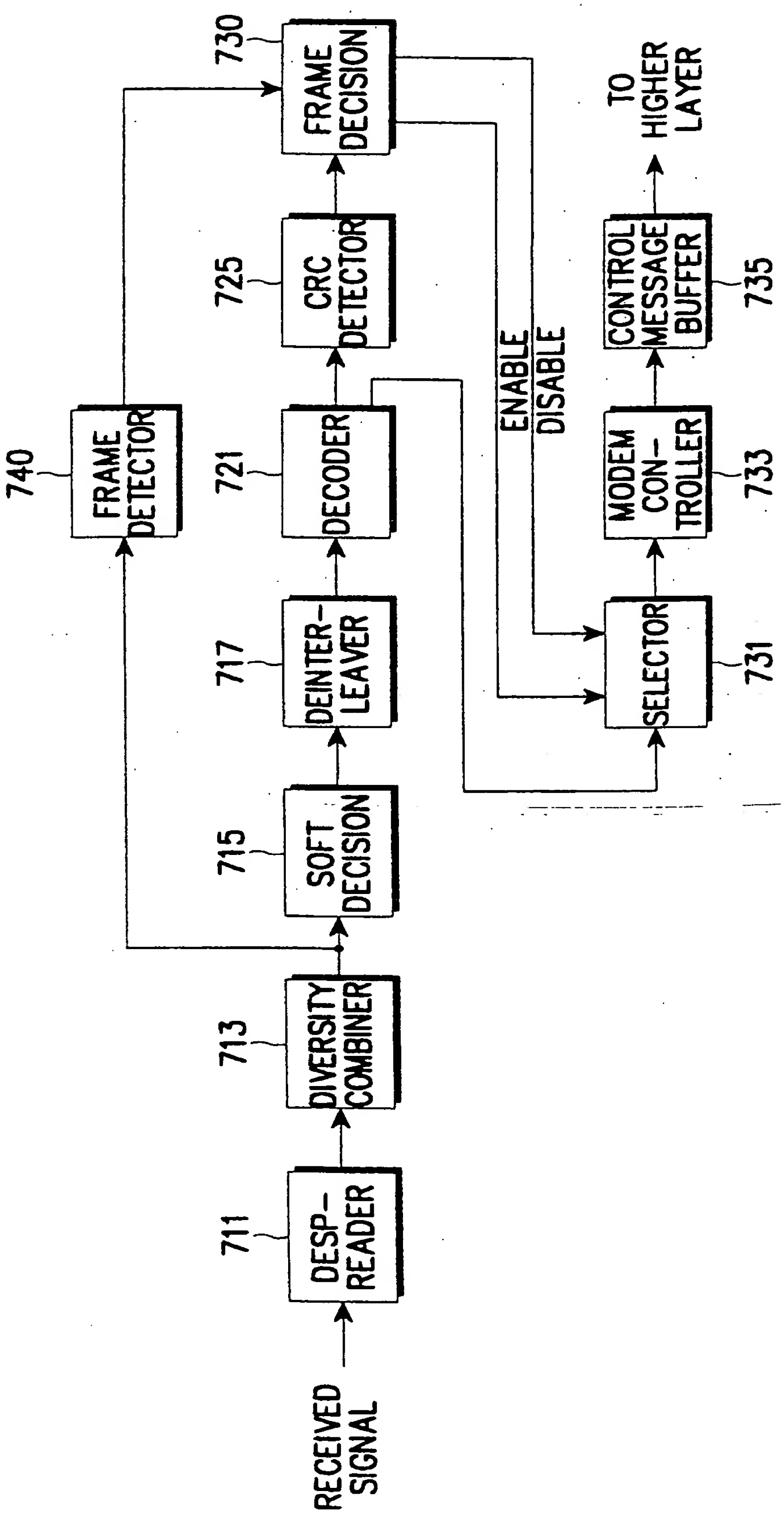

RECEIVED SIGNAL
DESP-READER
711
DIVERSITY COMBINER
713
SOFT DECISION
715
DEINTER-LEAVER
717
DECODER
721
CRC DETECTOR
725
FRAME DECISION
730
FRAME DETECTOR
740
ENABLE
DISABLE
SELECTOR
731
MODEM CON-TROLLER
733
CONTROL MESSAGE BUFFER
735
TO HIGHER LAYER

FIG. 8

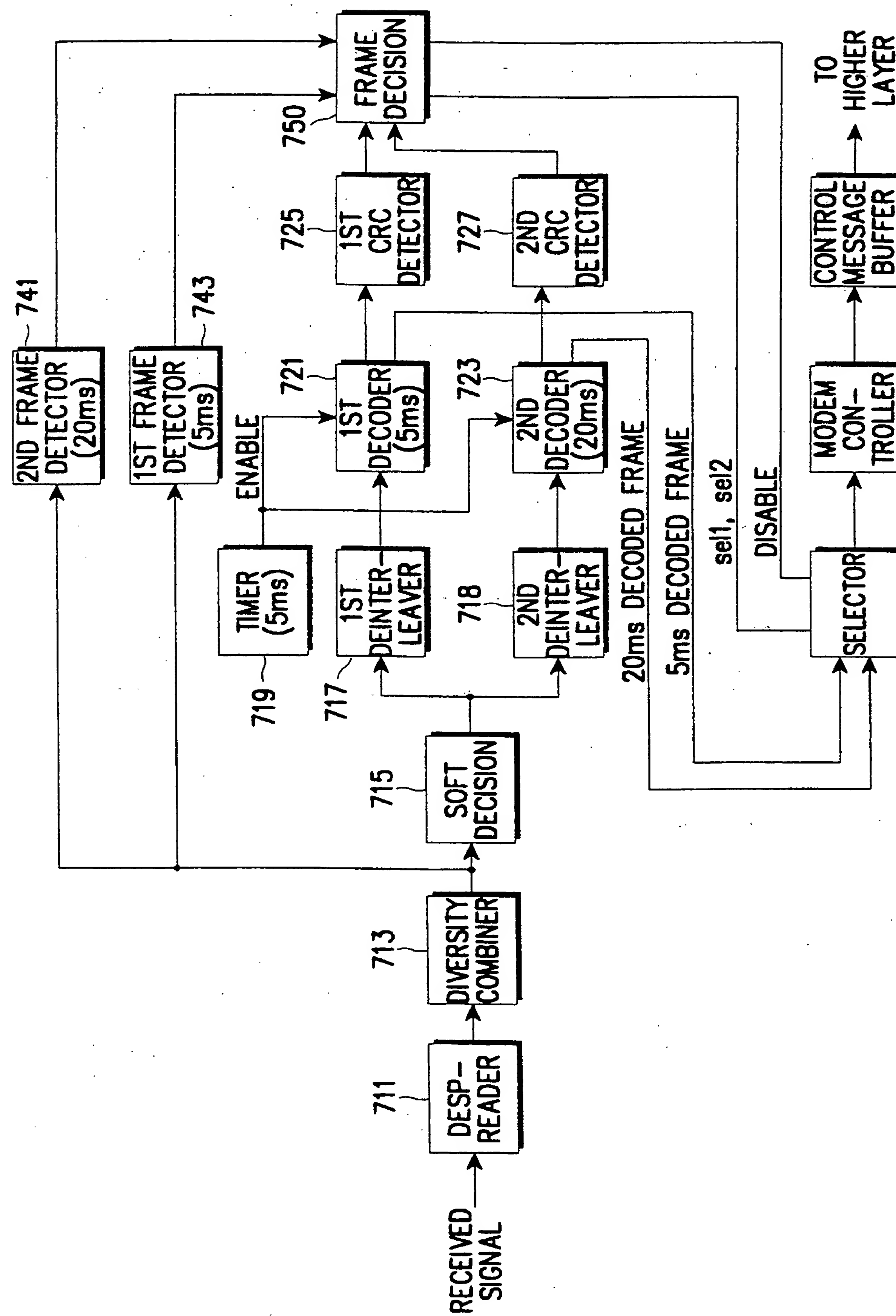

RECEIVED SIGNAL
711
DESP-READER
713
DIVERSITY COMBINER
715
SOFT DECISION
717
1ST DEINTER-LEAVER
718
2ND DEINTER-LEAVER
719
TIMER (5ms)
ENABLE
721
1ST DECODER (5ms)
723
2ND DECODER (20ms)
725
1ST CRC DETECTOR
727
2ND CRC DETECTOR
741
2ND FRAME DETECTOR (20ms)
743
1ST FRAME DETECTOR (5ms)
750
FRAME DECISION
20ms DECODED FRAME
5ms DECODED FRAME
sel1, sel2
DISABLE
731
SELECTOR
733
MODEM CON-TROLLER
735
CONTROL MESSAGE BUFFER
TO HIGHER LAYER

FIG. 9

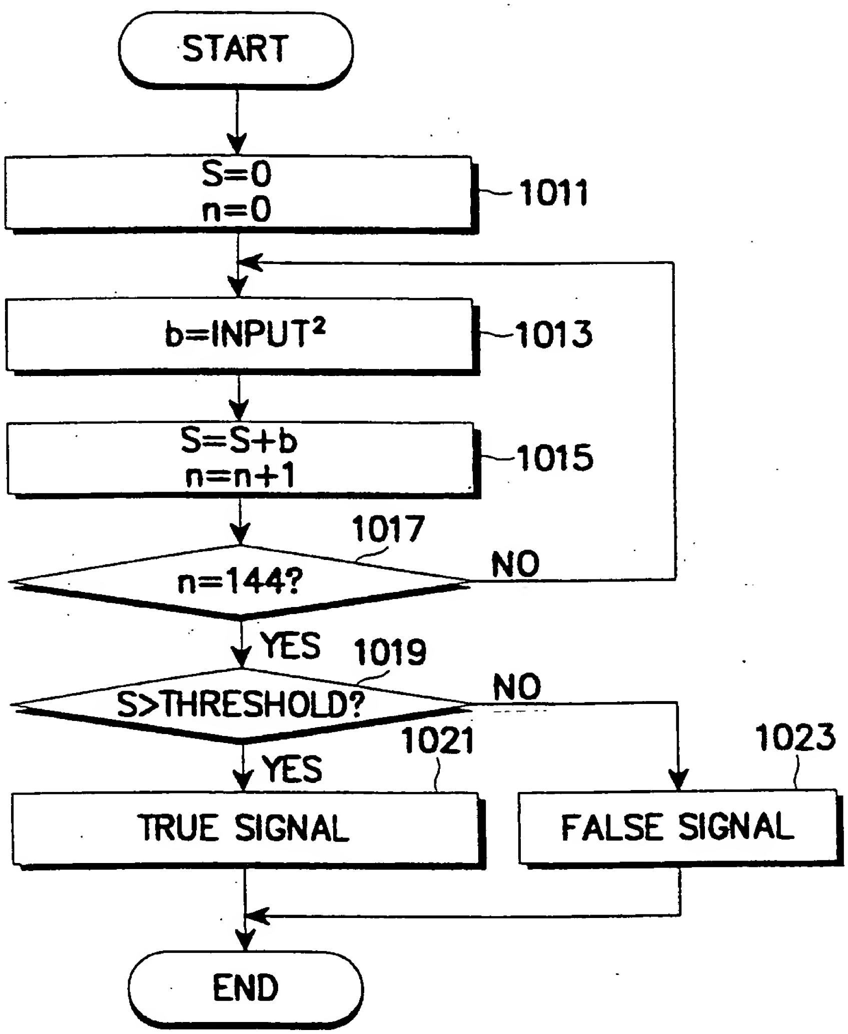

START
S=0
n=0
1011
b=INPUT²
1013
S=S+b
n=n+1
1015
1017
n=144?
NO
YES
1019
S>THRESHOLD?
NO
1021
YES
1023
TRUE SIGNAL
FALSE SIGNAL
END

FIG. 10

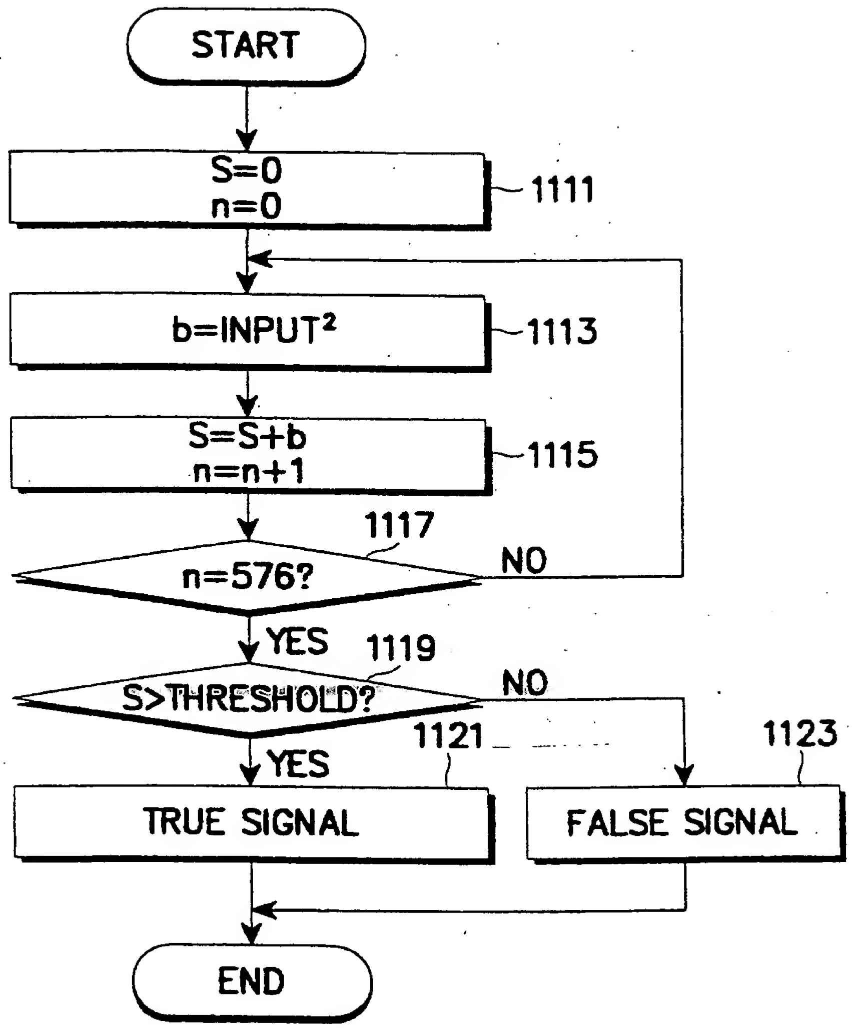

START
S=0
n=0
1111
b=INPUT²
1113
S=S+b
n=n+1
1115
1117
n=576?
NO
YES
1119
S>THRESHOLD?
NO
1121
1123
YES
TRUE SIGNAL
FALSE SIGNAL
END

FIG. 11

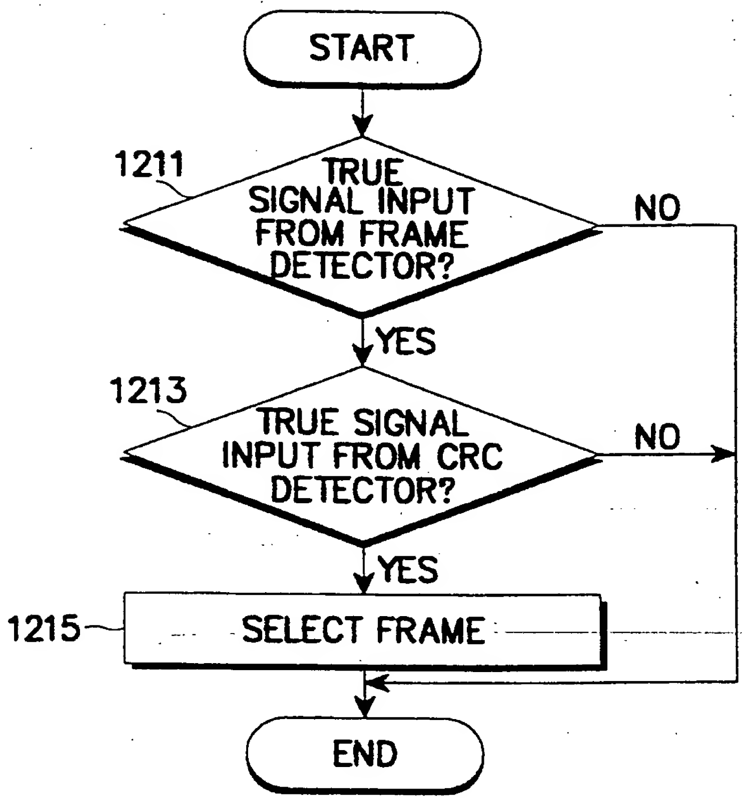

START
1211
TRUE SIGNAL INPUT FROM FRAME DETECTOR?
NO
YES
1213
TRUE SIGNAL INPUT FROM CRC DETECTOR?
NO
YES
1215
SELECT FRAME
END

FIG. 12

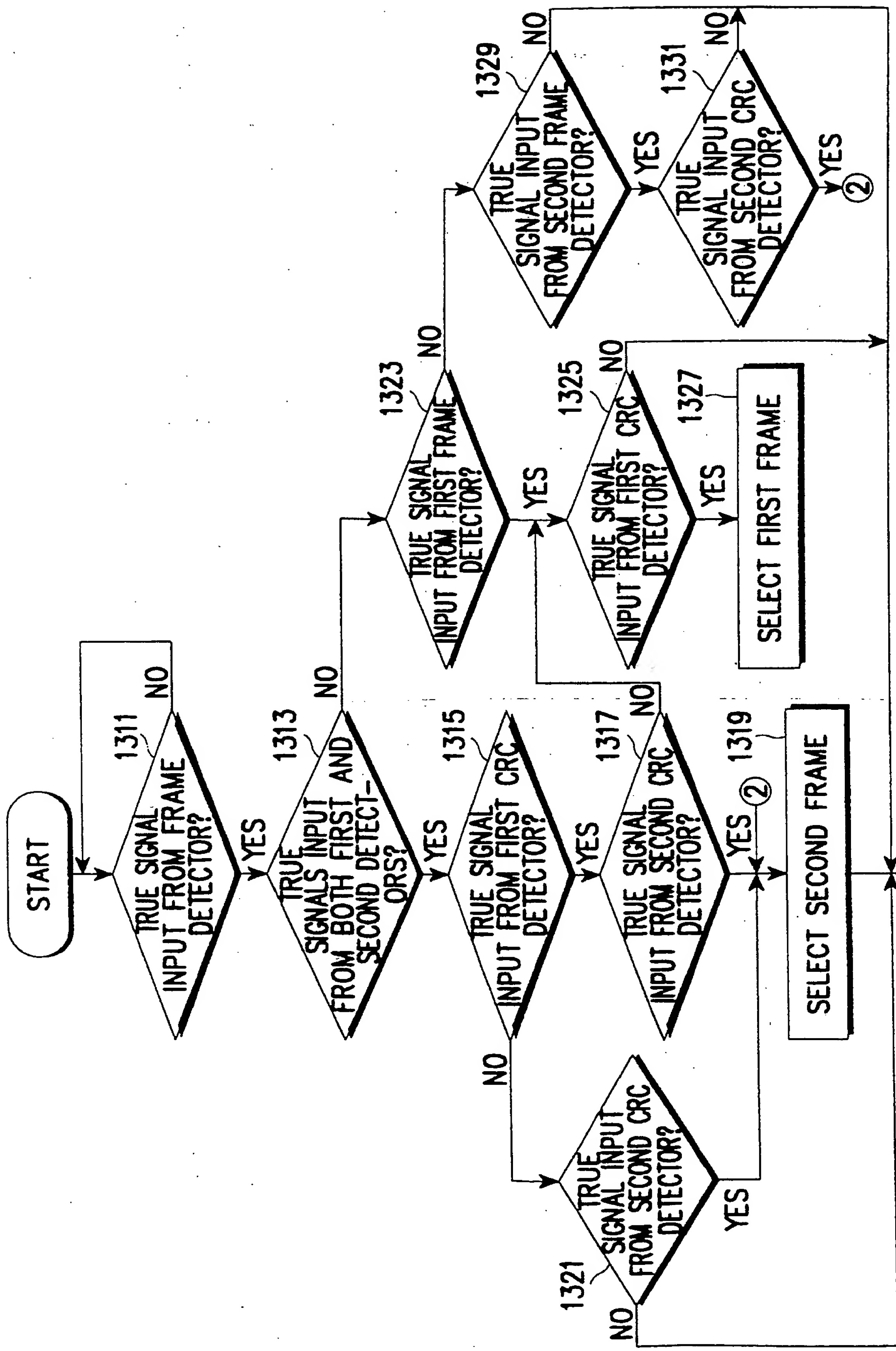

START
TRUE SIGNAL INPUT FROM FRAME DETECTOR?
1311
NO
YES
TRUE SIGNALS INPUT FROM BOTH FIRST AND SECOND DETECT-ORS?
1313
NO
YES
TRUE SIGNAL INPUT FROM FIRST CRC DETECTOR?
1315
NO
YES
TRUE SIGNAL INPUT FROM SECOND CRC DETECTOR?
1317
NO
YES
2
SELECT SECOND FRAME
1319
TRUE SIGNAL INPUT FROM SECOND CRC DETECTOR?
1321
NO
YES
TRUE SIGNAL INPUT FROM FIRST FRAME DETECTOR?
1323
NO
YES
TRUE SIGNAL INPUT FROM FIRST CRC DETECTOR?
1325
NO
YES
SELECT FIRST FRAME
1327
TRUE SIGNAL INPUT FROM SECOND FRAME DETECTOR?
1329
NO
YES
TRUE SIGNAL INPUT FROM SECOND CRC DETECTOR?
1331
NO
YES
2
END

FIG. 13

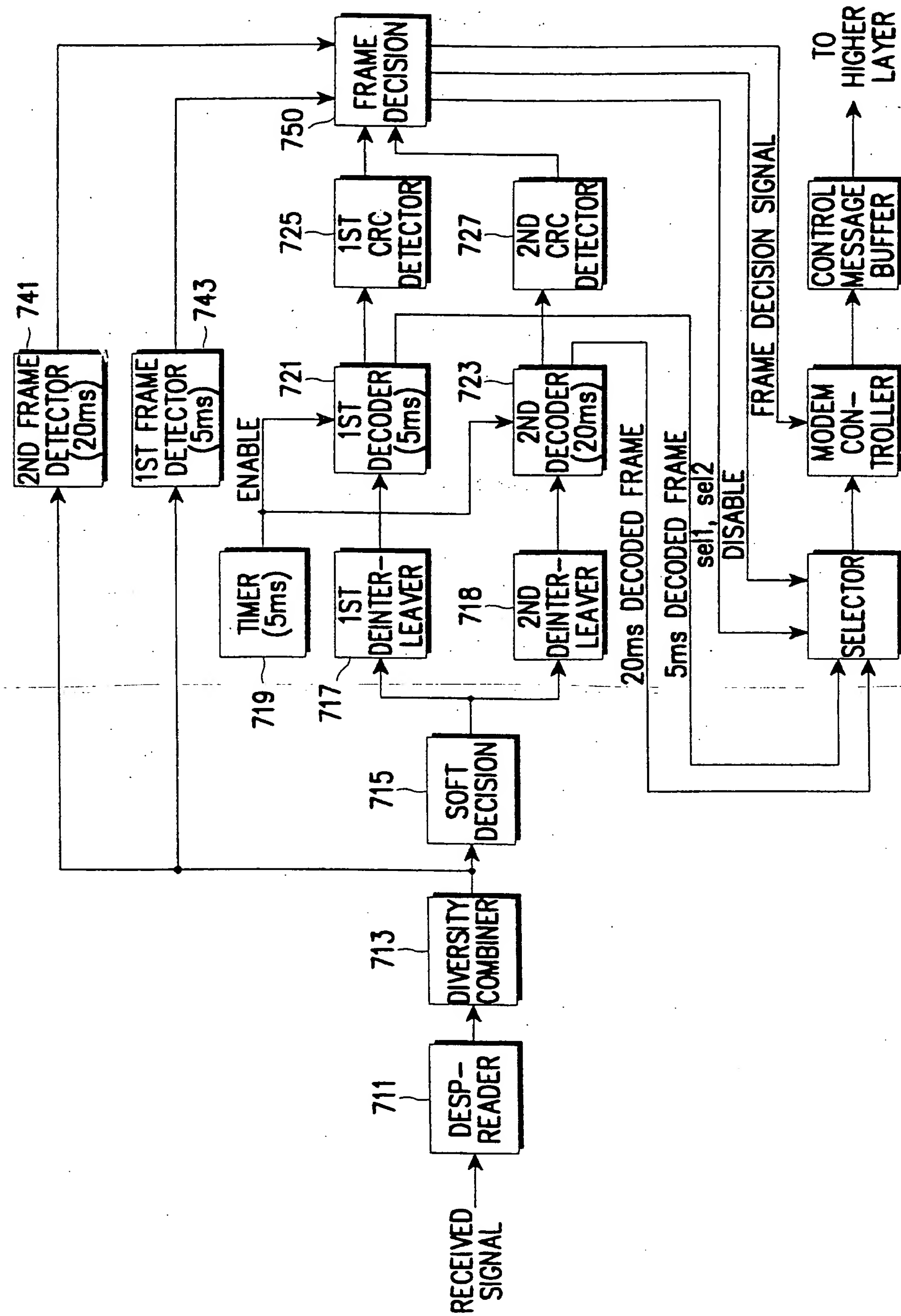

RECEIVED SIGNAL
711
DESP-READER
713
DIVERSITY COMBINER
715
SOFT DECISION
717
1ST DEINTER-LEAVER
718
2ND DEINTER-LEAVER
719
TIMER (5ms)
ENABLE
721
1ST DECODER (5ms)
723
2ND DECODER (20ms)
725
1ST CRC DETECTOR
727
2ND CRC DETECTOR
741
2ND FRAME DETECTOR (20ms)
743
1ST FRAME DETECTOR (5ms)
750
FRAME DECISION
20ms DECODED FRAME
5ms DECODED FRAME
sel1, sel2
DISABLE
FRAME DECISION SIGNAL
731
SELECTOR
733
MODEM CON-TROLLER
735
CONTROL MESSAGE BUFFER
TO HIGHER LAYER

FIG. 14

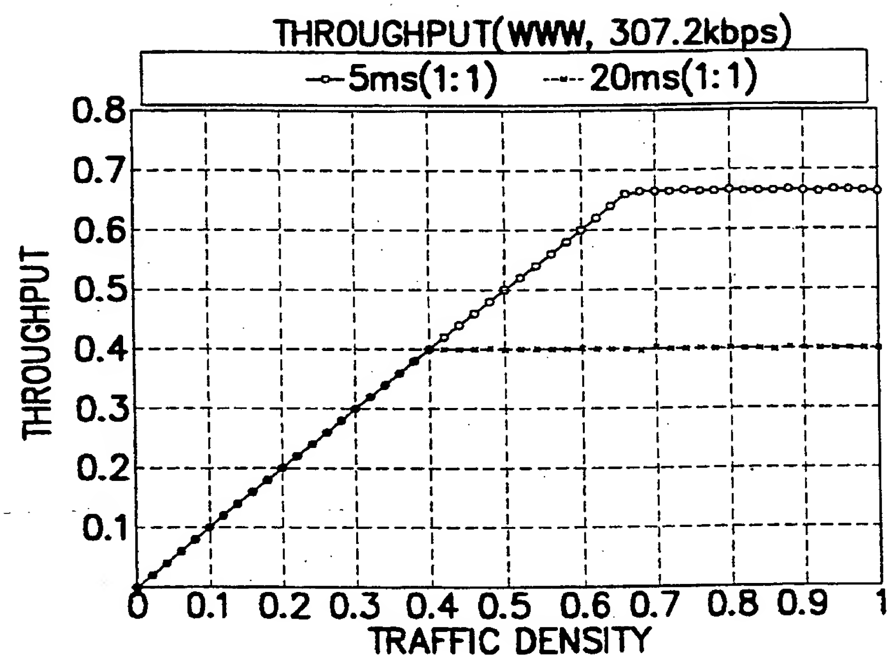

THROUGHPUT(WWW, 307.2kbps)
5ms(1:1)
20ms(1:1)
THROUGHPUT
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
TRAFFIC DENSITY

FIG. 15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR 99/00075

A. CLASSIFICATION OF SUBJECT MATTER

IPC^6: H 04 B 7/216, H 04 Q 7/34

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC^6: H 04 B 7/216, 7/26; H 04 Q 7/20, 7/22, 7/30, 7/32, 7/34, 7/38

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 730 356 (QUALCOMM INCORPORATED) 04 September 1996 (04.09.96), fig. 1-2h; abstract; page 5, lines 17-50; page 6, lines 5-10.	1,9,15,18,22,27-29
A	WO 95/24 771 A2 (NOKIA TELECOMMUNICATIONS) 14 September 1995 (14.09.95) fig. 4a-4b; page 9, lines 9-35.	1,9,15,18,22,27-29

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
„A" document defining the general state of the art which is not considered to be of particular relevance
„E" earlier application or patent but published on or after the international filing date
„L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
„O" document referring to an oral disclosure, use, exhibition or other means
„P" document published prior to the international filing date but later than the priority date claimed

„T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
„X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
„Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
„&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
03 May 1999 (03.05.99)	08 June 1999 (08.06.99)

Name and mailing adress of the ISA/AT	Authorized officer
Austrian Patent Office Kohlmarkt 8-10; A-1014 Vienna Facsimile No. 1/53424/535	Dröscher Telephone No. 1/53424/320

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR 99/00075

Im Recherchenbericht angeführtes Patentdokument / Patent document cited in search report / Document de brevet cité dans le rapport de recherche	Datum der Veröffentlichung / Publication date / Date de publication	Mitglied(er) der Patentfamilie / Patent family member(s) / Membre(s) de la famille de brevets	Datum der Veröffentlichung / Publication date / Date de publication
EP A2 730356	04-09-1996	AT E 156954	15-08-1997
		AU A1 34767/93	03-08-1993
		AU B2 668378	02-05-1996
		AU A1 47911/96	16-05-1996
		AU B2 683597	13-11-1997
		CN A 1081040	19-01-1994
		DE C0 69313098	18-09-1997
		DE T2 69313098	12-03-1998
		DK T3 621998	16-03-1998
		EP A1 621998	02-11-1994
		EP A4 621998	18-01-1995
		EP A3 730356	20-11-1996
		EP B1 621998	13-08-1997
		ES T3 2108260	16-12-1997
		FI A0 943410	18-07-1994
		FI A 943410	16-09-1994
		GR T3 3025048	30-01-1998
		HK A1 1000689	17-04-1998
		IL A0 118832	31-10-1996
		IL A1 104412	14-11-1996
		IL A1 118832	10-03-1998
		JP T2 7506469	13-07-1995
		NO A0 942670	15-07-1994
		NO A 942670	16-09-1994
		PL B1 172909	31-12-1997
		WO A1 9314588	22-07-1993
		ZA A 9300290	22-11-1993
		US A 5511073	23-04-1996
		US A 5504773	02-04-1996
		US A 5568483	22-10-1996
		BR A 9305758	28-01-1997
		AU A1 84016/91	23-01-1992
		AU B2 652956	15-09-1994
		BG A 97222	27-05-1994
		BG B1 61514	31-10-1997
		BR A 9106592	08-06-1993
		CA AA 2085890	26-12-1991
		CN A 1061312	20-05-1992
		CZ A3 9203871	17-11-1993
		CZ B6 283123	14-01-1998
		EP A1 536334	14-04-1993
		EP A4 536334	01-12-1993
		FI A 925812	21-12-1992
		FI A0 925812	21-12-1992
		HU A0 9204111	29-03-1993
		HU A2 64657	28-01-1994
		IL A0 98598	15-07-1992
		JP T2 6501349	10-02-1994
		KR B1 134390	27-04-1998
		MX B 173818	29-03-1994
		NO A 925019	23-12-1992
		NO A0 925019	23-12-1992
		PT A 98079	31-08-1993
		SG A1 52735	28-09-1998
		SK A3 3871/92	10-08-1994
		US A 5103459	07-04-1992
		WO A1 9200639	09-01-1992
		ZA A 9104847	29-04-1992
		US A 5309474	03-05-1994
		US A 5416797	16-05-1995
		US A 5715236	03-02-1998
		US A 5841806	24-11-1998
		US A 5535239	09-07-1996
		US A 5629955	13-05-1997
		US A 5659569	19-08-1997
		AU A1 47603/96	07-08-1996
		AU B2 694612	23-07-1998
		BR A 9606833	30-12-1997
		CA AA 2210657	25-07-1996
		EP A1 804836	05-11-1997
		FI A0 972990	14-07-1997
		FI A 972990	17-09-1997
		IL A0 116790	14-05-1996
		JP T2 10512415	24-11-1998
		WO A1 9622639	25-07-1996
		ZA A 9600181	14-10-1996

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR 99/00075

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO A2 9524771	14-09-1995	AU A1 17094/95	25-09-1995
		AU B2 690218	23-04-1998
		CN A 1142295	05-02-1997
		EP A1 748541	18-12-1996
		FI A0 940981	01-03-1994
		FI A 940981	02-09-1995
		FI B 98332	14-02-1997
		FI C 98332	26-05-1997
		JP T2 9510057	07-10-1997
		NO A 963638	30-08-1996
		NO A0 963638	30-08-1996
		WO A3 9524771	02-11-1995

This Page Blank (uspto)